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CYBERNETICS, COMPUTERS AND
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No. 52



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CYBERNETICS, COMPUTERS AND AUTOMATION TECHNOLOGY

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CONTENTS

HARDWARE

The Applications of a Programmable Controller to a Testing Control System	1
The Possibilities for the Use of Multioperation Microprocessors in Automation Systems for Scientific Experiments	3
Microcalculators in the Movie Industry	5
New Optical Device for Air Traffic Control Work	8
A YeS Computer Input-Output Image Device Based on the R-1700 'Photomation' Scanner	10
120T-1370 Disc Storage	15
Abstracts of Articles From the Journal of Control Automation and Mechanization	18
Control Program of the Communications Processor for a Computer Network With Packet Switching	20
One Approach to Designing Interface Control Logic	35
Realization of Systems Not Fully Determined by Boolean Functions on Basis of Low and Medium Level Integrated Circuits	38
Minimizing the Area of Large-Scale Integrated Circuits in the Symbolic Method of Design	40
Memory Modules Using MDP BIS -- Broad Use Complementing Products	41

On Design of Multiple-Link Systems for Automating Scientific Experiments Using ODA-20 Apparatus	50
Program Packet for Processing Experimental Data	53
Organization of a Dialog System and Interpretation of Operator Interrogations in Automated Systems for the Control of Scientific Experiments	55
Monitoring and Diagnostics of a Disc Subsystem of the M4030-1 Computer	58

SOFTWARE

Software Development for "Dispatcher Collective Use Computers"	60
Business Games in the Training Process	62
Problems of Automating the Design of Data Bases	64
Selection of Data From Automated Data Banks and Its Optimization	66
Use of Facilities for Debugging Specific Programs for the Broad Purpose Microcomputer Family	67
One Approach to the Selection of Optimal Grouping of Direct-Access and External Memories of Computers ...	75
Digital Computer for Multichannel Processing of Experimental Data in Real Time (TsVK "PIRS")	77
Abstracts of Articles From the Journal of Control Systems and Machines	95
Man and Computer Dialog: Systems for the Design of Problem Solving Algorithms	98
A Man-Machine Solution Search Procedure in Multiple Criteria Optimization Problems	99
An Approximate Calculation of Productivity Losses and the Determination of the Loading of Multiprocessor Complexes in the Case of Conflicts in a Partitioned Common Memory	100
A Package of Programs for Checking Data Reliability in Automated Control Systems	101
On the Automated Preparation of Program Aggregates From Modules Using Different Languages	101

On One Approach to the Development of Automated Control System Software	102
On the Coding of Control Data in One Class of Redundant Codes	103
The ASP-53 Automated Design System for Multilayer Printed Circuit Boards Using a Topological Procedure ...	104
A Microprocessor System for the Automation of Experiments To Study the Strength of Materials - 'Prochnost'	105
An Automated Quality Control System for the Products of a Radio Engineering Enterprise	106
An Automated Information Retrieval System Based on the M-222 Computer	107

APPLICATIONS

Four Collective-Use Computing Centers in Test Operations ..	108
Test Run for Processing Census Material Made in Belorussia	118
Minicomputers in Stock Management	120
The Use of Computer Complexes To Automate the Control of Transportation Processes	122
ASU in City Management: Directions and Efforts	124
ASU's in Belorussia	130
Computerized Reservation System	137
Savings Realized by Use of Computers	148
New Computer Training Lab for Institute Students Working Well	158

CONFERENCES

All-Union Conference on the Automation of Control System Design	162
The Utilization of the Unified System of Electronic Computers and Mathematical Modeling in the Applications Sector	163

The 13th All-Union School on the Automation of Scientific Research	163
---	-----

PERSONALITIES

Authors of 'Control Systems and Machines' Articles	165
--	-----

PUBLICATIONS

Microprocessors and Microcomputers	169
Computer Technology and Microelectronics!	170
Data Processing and Software	171
Bibliographic Citations	172
List of Recent Articles on Computer Technology	175

HARDWARE

UDC 681.323:621.316.544.1-529

THE APPLICATIONS OF A PROGRAMMABLE CONTROLLER TO A TESTING CONTROL SYSTEM

Minsk MEKHAIZATSIYA I AVTOMATIZATSIYA UPRAVLENIYA in Russian No 1, 1980
p 49 manuscript received 22 May 79

[Excerpt from the article by V.V. Reutov, candidate of the engineering sciences and T.Z. Aralbayev, engineer]

[Excerpt] A programmable controller has been developed in the Institute of Cybernetics of the Ukrainian SSR Academy of Sciences, which is included as the control device in the products list of the blocks of modules of the SKETOR USTS [standardized system of hardware], which is intended for program control of the data exchange between the modules of the SKETOR USTS, the primary data processing and digital control. It consists of the following units: the control unit (BU) for generating the requisite sequence of functional signals when controlled from the SEKTOR USTS control console and when controlled from a program written in the memory; an operational unit (BO) for the execution of arithmetic and logic transformations of the data; an operational memory (BOP) for processing and storing the program during the testing time; a permanent memory (BPP) for storing the processed, frequently repeated programs; and an input-output unit for the programs on magnetic tape and an input-output unit for the programs on a "Konsul" printer.

In structural terms, all of the PK [programmable controller] units are built on separate circuit boards; in this case, the basic component unit is the K 155 integrated circuit. The operational memory unit is built using the KS65RUI integrated circuit dynamic type memories, while the permanent is designed around elements with a ferrite memory.

THE TECHNICAL CHARACTERISTICS OF THE PROGRAMMABLE CONTROLLERS

Word length	12
The time for executing one elemental operation	10 microseconds
Memory capacity (expandable), K words:	
operation	4-16
permanent	0.5-2

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THE POSSIBILITIES FOR THE USE OF MULTIOPERATION MICROPROCESSORS IN AUTOMATION SYSTEMS FOR SCIENTIFIC EXPERIMENTS

Minsk MEKHANIZATSIYA I AVTOMATIZATSIYA UPRAVLENIYA in Russian No 1, 1980 pp 45, 46, 48 manuscript received 22 May 79

[Excerpts from article by S. I. Yusifov, engineer]

[Excerpt] At the present time, systems of the SEKTOR and CAMAC type are used to interface a facility to microprocessors, controllers, exchange drivers, etc. The experience with the utilization of these systems for contemporary scientific experiment automation systems indicates the expediency of using microprocessor tools.

The typical word lengths of microprocessor vary in a range of 4 to 16 bits with a discreteness of 4 bits. As a rule, the word length of a microprocessor is determined by its area of application [3]. However, in accordance with the requirements of the diversity of information and the complexity of the series of automation facilities, as well as the limitations placed on cost, operational speed, reliability and other parameters of computers, there arises the problem of selecting an optimal microprocessor structure, which meets the criteria of efficiency and the specified limitations.

Two types of microprocessors (MP) structures are treated below: a traditional type with one operational device (OU) and a multioperation type (MOMP) with several OU's.

The proposed approach to the selection of the type of microprocessor is based to a considerable extent on the characteristics of the algorithm. In the case of a high frequency of the occurrence of single word operations

and a low level of parallelism, the use of conventional microprocessor will be effecient. With an increase in the degree of parallelism and the rate of occurrence of multiword operations, the efficiency of the utilization of MOMP's increases, something which can be seen from the estimates given here.

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MICROCALCULATORS IN THE MOVIE INDUSTRY

Moscow TEKHNIKA I KINO in Russian No 2, 1980 pp 6, 7, 15

[Article by A. B. Berkenheim: "Programming sensitometer tasks on the Elektronika B3-21" microcalculator"]

[Excerpts] Improving the accuracy of existing sensitometer methods for controlling the production processes of printing and processing at the present time is impossible without drawing on the facilities of computer technology [1]. In a wide variety of motion-picture enterprises this problem is solved through the use of a mini-computer with appropriate software [2, 3]. However, enterprises without access to a computer must also improve the accuracy and representational quality of sensitometer control. This purpose can be served by the use of a new class of computational devices--the programmable microcalculators, which by nature occupy an intermediate position between arithmetic calculators and minicomputers.

The purpose of this study involved the developmental and experimental verification of software to allow the B3-21 calculator to be used for the solution of a series of sensitometric problems. Basically, we used computational algorithms which are close to those used for the automated control of the production processes for printing film materials [3, 4]. There was also the problem of evaluating the ergonomic aspects of the use of the programmable calculator as a means for operational control and management in the processes of printing and processing. It should be noted that the computational capabilities of the programmable micro-calculator do not by any means lead to an unconditionally correct and absolutely exact performance of the tasks considered in all cases. Nevertheless, the programs cited, when verified on a large number of practical examples yielded results corresponding to those produced by traditional graphic-analytic methods and computer calculations. The programs which are the precise mathematical embodiment of the required computational process are given the index "M" to distinguish them from programs in which simplified algorithms are realized and which theoretically can be "fooled" by some specific set of input data.



Fig. 1: The Programmable microcalculator "Elektronika B3-21."

The "Elektronika B3-21" microcalculator (Fig. 1) for which the programs were developed, operates with eight bit numbers in the range 10^{-99} to 10^{+99} . The input of numbers and operations on them are implemented by pressing the appropriate digital and functional keys on the calculator. The source data and result of the calculations are indicated on a light-emitting diode. As a programmable calculator, the B3-21 can perform a calculation automatically and step by step according to a program of up to 60 steps, which has previously been entered into the program memory of the calculator. The program can contain branches and unconditional branches, access to subroutines with a depth of access equal to 5. The average time to execute one arithmetic operation is .5 sec. Entering of the programs is accomplished in program mode by pressing the keys for the appropriate functions or operators, the codes for which are indicated on the light emitting diode and are stored. There are special keys to start or stop the program or return to the beginning. When the calculator is shut off the program and data are erased automatically. The memory resource for data storage consists of eight program addressable registers and a ring stack of seven registers.

The B3-21 calculator with the C-1 program entered in it makes it possible to calculate the value of photographic sensitivity and the coefficient of contrast of one layer of a photographic material in 1.5 minutes.

Reference

2. Artyushin, L. F., Kopytov, V. V. A mathematical model of the process of printing film materials "Proceedings of the NIKFI (Scientific-research Motion-picture Institute," 1977, vol. 88, pp. 7-12.

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NEW OPTICAL DEVICE FOR AIR TRAFFIC CONTROL WORK

Moscow GRAZHDANSKAYA AVIATSIYA in Russian No 3, 1980 pp 20-21

[Interview with G. G. Gromov, head of the laboratory of videothermal complexes of the Institute of Electronics and Computer Technology of the Academy of Sciences Latvian SSR, by S. Zigunenko: "The Computer Acquires Sight"]

[Excerpts] G. G. Gromov, head of the laboratory of videothermal complexes of the Institute of Electronics and Computer Technology of the Academy of Sciences Latvian SSR, tells of the creation of computer "vision."

[Answer] Specialists at the Institute of Biophysics of the Academy of Sciences USSR, working together with designers from East Germany under the direction of academician G. M. Frank and G. R. Ivanitskiy, corresponding member of the Academy of Sciences USSR, made the quality of the analysis one of their paramount objectives. The result of their work was the Morfokvant, an instrument of extraordinarily great precision.

The electronic eye of the Morfokvant is a scanning microscope which is connected to the computer by a photomultiplier and analog-code converter. The object is scanned in sequence, point by point. To do this a two-step system of precision step engines moves the slide and part of the optical system of the microscope with a step of 0.1-3.2 microns. This makes it possible to sense the boundaries of the object precisely and carefully draw its outlines. The computer of the Morfokvant, following a program stored in it, can sort objects into 120 groups, classify them by optical density, spectrum, and perimeter length, and estimate the degree of curvature in its outline. This information is fed in the form of digits and graphs.

Then we have the Rastr (Raster), Kadr [Frame], and other devices made in our institute under the direction of academician of the Academy of Sciences Latvian SSR E. A. Yakubaytis. They are designed principally for operational analysis and take only one-fourth of a second to investigate an object. This speed is very useful at airport air traffic control points.

Because our instruments are to be produced in large series we try to make maximum use of devices and assemblies that already exist. The electronic eye of the system is a conventional industrial television camera. The analog-code convertor is one of many produced by our industry. The computers are also series-produced machines, except we wrote special programs for them.

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A YES COMPUTER INPUT-OUTPUT IMAGE DEVICE BASED ON THE R-1700 'PHOTOMATION' SCANNER

Leningrad IZVESTIYA VUZOV, PRIBOROSTROYENIYE in Russian No 2, 1980 manuscript received 23 Nov 78 pp 48-51

[Article by V. M. Zaytsev and A. A. Chigirev, Leningrad Institute of Precision Mechanics and Optics]

[Text] An input-output imaging device with drum-type electromechanical scanning for the YeS EVM (Unified computer system) and its functioning are described and the block-diagram and the main specifications of the input-output device are presented.

The input-output imaging device is used to measure and record in numerical form the values of the optical densities of images, to transmit received readings to the computer and also to receive digital readings from the computer and to reproduce half-tone images from them. It is designed to operate as one of the specialized peripherals in a multipurpose digital image processing system which includes the YeS-1020 computer with standard set of external equipment [1] and is connected to the multiplex channel of the system processor.

The device was developed on the basis of the R-1700 'Photomation' scanner, produced by the OPTRONICS Company [2], which has the following main parameters:

Maximum image size	220 X 230 mm
Dimensions of expansion element	25 X 25; 50 X 50; 100 X 100 microns
Range of optical densities:	
during reading	0 - 2D and 0 - 3D
during reproduction	0 - 2.5D
Number of quantification levels	256
Number of reproducible gradations	64
Quantification frequency	28 kHz

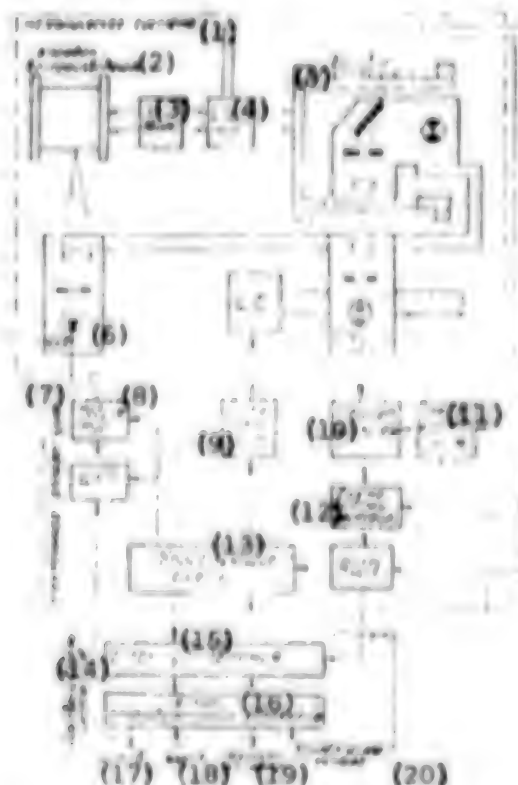
Input (output) time of image measuring

220 X 230 mm with aperture:

25 microns	96 min
50 microns	24 min
100 microns	6 min

The R-1700 scanner is matched to the computer by the input-output interface of the YeS EVM [3]; therefore, the input-output device can be used with any of the computers of the family of the Unified System.

The main assemblies of the device are (see figure): a mechanical system with rotary drums (the input photograph is attached to one and the photographic material to be exposed is attached to the other) and with carriages for the photoreadout and photoreproducing assemblies arranged in parallel to the generatrices of the step motor drums; electronic apparatus for controlling the readout and reproduction processes, an interface converter, the need for which is caused by the fact that the R-1700 apparatus is designed to be connected to a minicomputer of ALPHA-16 type whose interface differs considerably from that of the externals of the YeS EVM.



Key:

- | | |
|----------------------|-------------------|
| 1. Mechanical system | 3. Electric motor |
| 2. Reproducing drum | 4. Decoder |

[Key continued on following page]

[Key continued from preceding page]

- | | |
|-----------------------------|--------------------------------|
| 5. Readout drum | 13. Control circuits |
| 6. Photomultiplier | 14. Interface converter |
| 7. Electronic apparatus | 15. Control block |
| 8. Modulator | 16. Standard integration block |
| 9. Amplifier | 17. Bus A |
| 10. Logarithmic amplifier | 18. Bus K |
| 11. Zero correction circuit | 19. User bus control |
| 12. Sampling circuit | 20. Channel bus control |

The image input-output device functions in the following manner. The photograph subject to input is attached on the readout drum, which is rotated at constant speed by a synchronized motor. The luminous flux passing through the scanning element of the image is separated by the aperture diaphragm of the photoreadout assembly, which can be moved along the generatrix of the drum by a step motor controlled by instructions from the computer. This luminous flux is converted by a photomultiplier to the voltage fed to the logarithmic amplifier, from whose output the voltage proportional to the optical density of the measured image expansion component is tapped. A "zero drift" correction circuit is used in the logarithmic amplifier. An analog-digital converter (ATsP) sends an eight-digit optical density binary code to the interface converter for subsequent transmission to the channel. A sampling and fixing circuit, which is controlled from the decoder of the angular position of the drum, is used at the ATsP input to obtain digital readings strictly in the square lattice assemblies.

Upon reproduction of the image, the scanning mechanism functions in a similar manner, except the optical density codes enter from the channel through the interface converter to the digital-analog converter (TsAP) from whose output the voltage which controls the light diode current of the photoreproducing assembly is tapped. The exposure times are synchronized by pulses of the angular drum position decoder to obtain the image scanning elements strictly in the square lattice assemblies.

The interface converter performs the following main functions:

--it receives and decodes the real instructions from the channel, converts them to control instructions for the R-1700 apparatus and monitors execution of them;

--it receives the optical density codes from the R-1700 apparatus to the output information register for subsequent transmission of them to the channel;

--it receives data bytes from the channel to the input information register for subsequent transmission of them to the R-1700 apparatus;

--it receives control signals from the R-1700 apparatus to ensure joint functioning;

--it sends control signals and instructions to the R-1700 apparatus;

--it sends information about the current state of the input-output device and about execution of the given instructions by it to the channel.

The interface converter includes the control block (UP) and the standard integration block (BSS).

The control block contains 16-digit input and output information registers with gated inputs and output, an instructions decoder and control and monitoring circuits. The control and display members required by the operator to analyze the functioning of the input-output device are located on the operator's console. The control members which permit control of the operating modes of the device are located on the engineer's console.

The standard integration block contains a control circuit, instructions decoder and register, the address decoding circuit of the device, and address generator designed to transmit the actual address of the device to the channel, registers of state and of refined state, a parity generator for imparting the monitoring digit to the data transmitted to the channel and a parity monitoring circuit of the data coming from the channel.

The data, information of state and refined state of the device, instructions, addresses and control signals are transmitted in both directions by interface lines which provide unified principles of data exchange between the external device and the YeS EVM channel.

The device exchanges data with the multiplex channel in monopole mode. In this case the data of each line are placed in the internal storage (OZU). Since the data of the entire image cannot be stored in the OZU because of the large number of quantification elements, the OZU is used as a buffer storage for one line only. After input or output of one line of the image is completed, either the data from the OZU are re-recorded on magnetic tape (NML) or magnetic disc (NMD) stores in the "Input" mode or the data of the next line are re-recorded from the NML or NMD to the OZU in the "Output" mode.

The input-output image device is controlled from the computer, which issues a number of instructions in a specific sequence, each of which ensures that the device will execute one of the following operations: reading one line of the image, recording of one line of the image, moving the carriages of the photoreadout and reproducing assemblies a given distance to the left or right, omission of a given number of readings prior to the beginning of issuing data to the channel or receiving data from the channel when executing readout or record instructions. The required number of data bytes transmitted through the channel is determined by the channel. This permits input (output) of any given segment of the total image.

The YeS-7022 standard device, developed according to the functional characteristics of the R-1700 apparatus, is used as an interface converter.

Selection of the YeS-7022 device was determined by the fact that it is made in the form of a functionally and structurally complete product; it permits joint functioning with the R-1700 apparatus with comparatively small volume of operations; it contains a minimum number of unutilized blocks and assemblies; it has reserve locations on the frames which can be used to locate additional functional blocks; and it has comparatively low cost and is the most readily available.

Analyses of the feasibility of using the YeS-7022 device when solving the postulated problem are more general in nature and can be used in similar cases.

The input-output image device has been operated successfully since 1977, which confirms the correctness of the selected engineering solutions.

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3. Drozdov, Ye. A., V. A. Komarnitskiy and A. P. Pyatibratov, "Elektronnyye vychislitel'nyye mashiny Yedinoi sistemy" [Computers of the Unified System], Moscow, Mashinostroyeniye, 1976.

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[8144/1026-6521]

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IZOT-1370 DISC STORAGE

Kiev ENERGETIKA I ELEKTRIFIKATSIYA in Russian No 1, 1980 pp 39-40

[Article by V. A. Ovcharenko and A. I. Samokhvalov, engineers: "Operating Experience of Izot-1370 DC Motor-Powered Disc Storage"]

[Text] The Kharkov'energo PEO [Economic Planning Department, Khar'kov Power System] in 1978 started to operate an M-6000 computer which incorporates Izot-1370 disc storage units powered by DC motors.

This computer package serves as the basis for the functioning of a real-time system for the collection and display of dispatched information on the power system.

In the course of operation of the computer package it was found that defects of the stabilization system of spindle motor rotations restrict their service life--and hence also that of the Izot-1370 disc storage units--to as little as 500-600 hr.

The principal cause of the short service life is the burnout of the motor commutator at two diagonally opposite points.

A thorough investigation and analysis revealed that the motor performs under extremely difficult conditions resulting in its rapid breakdown.

The spindle motor rpm stabilization system is so designed by the manufacturing plant that powerful--of the order of 16 amp--control current reach the motor commutator at the instant when the indexing slit on the disc passes across the "index-sector" sensor, which corresponds to two (owing to the presence of two brush pairs) specific diagonally opposite points on the commutator.

As a result, the operation of the disc storage is accompanied by uneven performance of the commutator, increase in sparking, burnout of the commutator at these spots, and instability of the motor's rotations.

Experience shows that certain technical measures (cleaning, tooling of commutator, displacement of the spindle relative to the removable magazine) do not significantly prolong the service life of disc storage units.

Hence new measures were worked out to eliminate the aforementioned defects and enhance the operating reliability of disc storage.

A random delay unit was incorporated in the spindle motor rpm control circuit, thus making it possible to delay for varying intervals of time, within certain limits, the pulse proceeding to the input.

The unit is so designed that the maximum pulse delay time is roughly one-half of the indexing-pulse arrival period, i.e. one-half of a single revolution of the motor, in the presence of two poles on the motor.

Thus, the shaped powerful current pulses delayed with respect to the "index-sector" mark get uniformly distributed over the entire surface of the commutator and by the same token contribute to a uniform performance of the commutator over its periphery.

In addition, to improve the operating conditions of the motor, the conditions of rpm control were somewhat altered. The start-up and acceleration stage remained unchanged. Once 1800-200 rpm is attained, a rpm stabilization circuit is triggered, which actuates additional resistors in the motor power supply circuit so as to reduce the intensity of stabilization pulses from 16 to 10 amp.

Thus, the current pulse differential is reduced and, owing to the increase in the pulse duty ratio, rpm stabilization is unaffected.

These technical measures markedly facilitate the operating conditions of the motor and hence also greatly prolong the service life and operating reliability of disc storage.

These measures were carried out on pretooled previously broken-down motors.

Subsequent repeated inspections of the thus modified motors following long periods of operation revealed them to be in good condition, with an intact and burnout-free commutator.

These measures also resulted in a relative absence of wear of the brushes and hence also in a relative absence of dust inside the motor, which makes it possible to prolong the operating period of the motors prior to their preventive maintenance.

In addition to the above measures to increase the reliability and service life of the motors, several suggestions for accelerating error detection and improving the quality of performance of the motors have been adopted. In view of the absence of a monitoring batch and TIDU-4 tester, the interchangeability of the disc storage units is monitored with the aid of the computer and a specially compiled program based on the maxima of readout signals.

To reduce the repair periods, the contents of the current address cylinder register is placed on the front panel of disc storage and indicated with the aid of photodiodes. In our search for malfunctions we use a specially developed autonomous miniature pulse counter and state indicator assembled from integrated circuits.

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[288-1386]

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ABSTRACTS OF ARTICLES FROM THE JOURNAL OF CONTROL AUTOMATION AND
MECHANIZATION

Minsk MEKHANIZATSIYA I AVTOMATIZATSIYA UPRAVLENIYA in Russian No 1,
1980 p 64

UDC 681.325

A MULTICHANNEL FUNCTIONAL DATA CONVERTER IN SYSTEMS FOR THE AUTOMATION
OF SCIENTIFIC EXPERIMENTS AND TECHNOLOGICAL PROCESSES

[Abstract of article by Kozlov, L.G. pp 54-58]

[Text] Methods of improving the technical characteristics of data processing hardware in systems for automating scientific experiments and technological processes are considered. Because of the use of a systemic approach to the design of the hardware, the proposed multichannel data converter is distinguished by good operational quality and data processing efficiency in SANE [systems for automating scientific experiments] and ASUTT [automated systems for the control of technological processes].

Figures 1; references 3.

UDC 621.394.66

EQUIPMENT FOR THE EVALUATION OF THE QUALITY OF DATA TRANSMISSION VIA
COMMUNICATIONS CHANNELS

[Abstract of article by Starik, V.A., Shevchuk, V.I., Dryn', V.P. pp 58-60]

[Text] The specific features of the design of equipment for evaluating the quality of data transmission are treated, where the equipment is intended for ascertaining and recording distortions of data in data transmission channels, which are equipped with error protection devices. A block
Figures 1; references 4.

A DATA PROTECTION DEVICE FOR MAGNETIC TAPE RECORDING

[Abstract of article by Chernyshev, V.M. pp 60-61]

[Text] The specific reasons for the distortion of data during the recording of random flows on magnetic tapes and methods of combating these distortions are treated.

Figures 1, references 2.

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[277-8225]

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CSO: 1863

CONTROL PROGRAM OF THE COMMUNICATIONS PROCESSOR FOR A COMPUTER NETWORK WITH PACKET SWITCHING

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian, No 6, 1979 pp 9-15

[Article by V. V. Gusev, V. K. Koval'chuk, E. F. Kushner, A. P. Chernat]

[Text] Introduction

One of the basic problems in creating a computer network is providing data exchange between processes at a distance from each other. The transmitting medium may be organized in different ways. The basic requirements are the rapid and reliable transmission of any sequence of data bits. The most efficient method of communications in large computer networks at present is the packet switching method [1-3]. In this case, communications processors (KP) are located at network centers connected by separated telephone communications lines (Fig. 1).

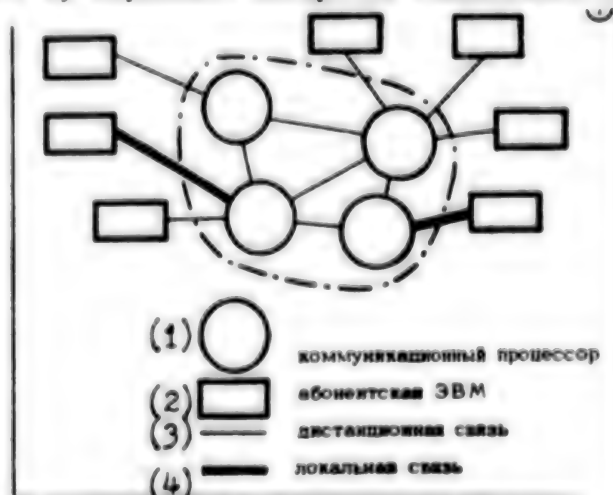


Fig. 1. Computer network with packet switching

- | | |
|-----------------------------|--------------------------|
| 1. Communications processor | 3. Remote communications |
| 2. Subscriber computer | 4. Local communications |

The topology networks and transit capacities of the lines are calculated to meet the requirements of reliability; speed of delivery, line loading and the cost of subnetwork communications.

Data from center to center are transmitted in portions (packets), whose size is limited and selected so as to achieve the maximum transmission speed at a given noise level in the direct-access memory unit, until a confirmation is received about the correct reception of the packet by the neighboring KP.

The packet consists of a title and text (the data proper). The title contains the addresses of the receiver and the sender, as well as service information which is processed by the KP and is used for introducing additional possibilities when transmitting the packets.

The computer network represents a most complicated system of programs and apparatus. In this connection, the generally accepted methodology in creating the networks is the representation of the network as a hierarchical structure with a clearly defined function of each level and protocols of interrelationship for all levels. The protocols regulate the data exchange, starting with the physical communications channel level to the functionally oriented levels (for example, protocols for file transmission, remote input of tasks, virtual terminal, etc.). At present, there are international standards for lower level protocols and work is being done on standardizing higher levels and the protocol system as a whole [4].

The International Consultative Commission on Telegraphy and Telephony developed standard X.25 for connecting subscriber computers (AVM) to a communications subnetwork for packet switching [5]. X.25 regulates three levels of connections: 1) physical connection, 2) control of the data channel and 3) packet interface. The virtual channels are determined on the third level. These channels are provided by a subnetwork for data transmission between a pair of network correspondents. The virtual channels are functionally equivalent to separated or switched communications channels, but use a new technology for data transmission -- packet switching. The data is sent to the receiver over the virtual channel in the same sequence as they were received by the communications subnetwork. The transmission speed in the channel is regulated by the receiver and the communications network. The virtual channel may be constant or may be established when necessary to transmit data and is destroyed after completion of the transmission. During the existence of the virtual channel, any amount of data can be transmitted over it.

An important problem in a computer network with packet switching is the selection of the interface type between the AVM and the communications subnetwork. Two types of such interface are well known: datagram and virtual channels [5]. Their comparison shows that each of these solutions has positive and negative sides. The datagram interface with the AVM was implemented in the control program of the communications processor (UPKP) developed in the IK [Cybernetics Institute] of the Ukrainian SSR AN for the SM-3 minicomputer. The operation with virtual channels and control between terminals are provided by a transport station (TS) included in the KP program. This solution simplifies KP software which should increase the reliability of the communications subnetwork. The basic KP function in this case is switching i.e., the selection of an output line for each received packet over which the packet will be transmitted to the next center, if it still has not reached its receiver. This selection is made on the basis of a routing table which is dynamically renewed in the process of KP operation and reflects the current topology and loading of the communications subnetwork. In the future, as the TS and KP software is being finished off, it is planned to increase the function of the KP, including the implementation of transport protocol in the communications subnetwork.

Apparatus. The KP was developed on the basis of the SM-3 minicomputer which was put into mass production in 1978. The machine family of this type also includes the more productive SM-4 and SM-5 models that are program compatible (from the bottom up) with the SM-3. The input-output interface of these machines (common bus) makes it easier to create multiple-processor systems. Series-produced microprocessors have the same interface. The SM-3 computer has a fairly highly productive processor (the cycle of the direct-access memory unit is 1.2 microseconds), a developed instruction system, 12 types of addressing, five levels of interrupt priorities, eight registers available to the programmer and apparatus for run-off. The configuration of the KP apparatus facilities is shown in Fig. 2.

Of the basic set of external devices, the SM-3 uses a display or a typewriter for communications with the operator, an input-output punched tape device and a real time clock. At present, it is possible to connect to the KP apparatus for data transmission of two types which were developed in the SKB [Special design bureau] IK Ukrainian SSR AN, apparatus for intermachine communications AMS [expansion unknown] and series-produced APD-MA-TF apparatus. The AMS provides semiduplex asynchronous communications over telephone channels with a speed of 2400 bits/sec for a distance of up to 20km; the APD-MA-TF provides for synchronous data transmission in the semiduplex mode with a speed of 1200 bits/sec independently of the length of the line.

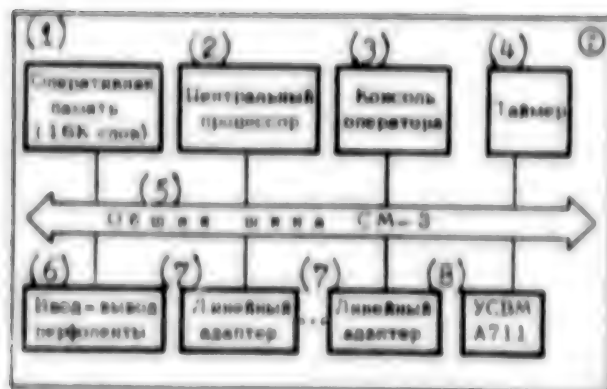


Fig. 2. Configuration of apparatus facilities

- | | |
|---|-------------------------------|
| 1. Direct access memory unit
(16K words) | 5. Common bus of the SM-3 |
| 2. Central processor | 6. Input-output punched tapes |
| 3. Operator's console | 7. Line adapter |
| 4. Timer | 8. USVM A711 |

The data transmission apparatus is connected to the common bus of the SM-3 by line adapters developed at the SKB IK Ukrainian SSR. The data exchange between the adapters and the direct-access memory unit is made under the control of the processor (program control exchange with bit-by-bit interruptions). The same type of line adapters may be used for communications between KP, as well as for communications between KP and type YeS processing computers through the MPD-3 data transmission multiplexer. The AMS is connected to the TA-2 asynchronous adapter, while the APD-MA-TF -- to the SA-2 synchronous adapter of the MPD-3 multiplexer.

It should be noted that the enumerated communications equipment does not satisfy the requirements of the network of teleprocessing and must be replaced as soon as the industry starts producing new apparatus for high speed data transmission in the duplex mode.

In local connections of KP to type YeS AVM, it is also proposed to utilize series manufactured the USVM-A711 computer machine communications device which operates at a speed of 700,000 bytes/sec with direct-access memory unit.

Protocols. Protocols are implemented in the KP for the three lowest levels of the computer network: the protocol for the physical channel, the protocol for data channel control and the packet communications control [1] .

The packet communications control sets the packet format and the method for transmitting packets to the communications subnetwork. In this implementation, the packet format was selected on the recommendations of the International Federation of Data Processing (IFIP). The length of the packet title was fixed at 18 bytes. The length of the text may vary from 0 to 255 bytes.

The title includes the following: a reserve for local communications network -- four bits, this reserve is for providing the possibility of operating with nonstandard packets; format version -- four bits, this reserve was made for introducing new types of formats that may appear in the future; packet type -- eight bits, this is used for marking specific types of packets, for example, priority or diagnostic; service -- 16 bits, here the special features are indicated for processing the packet in the network, for example, a requirement for sending diagnostic and tracing packets; text length -- 16 bits, although the maximum length of the text part of the packet is 225 bytes, this limitation may be changed in the future; therefore, more than eight bits were reserved for text length instruction which would have been enough for locating numbers from 0 to 225; address of receiver (sender) -- 48 bits, of which 32 are intended for identifying the TS and 16 bits -- instruction to the correspondent-process. At present, of the 32 bits of the TS identifier, only half are used; 12 bits determine the KP number and four bits -- the number of the TS connected to the given KP. The zero-th number of the TS indicates that the receiver (sender) of the packet is one of the KP processors.

Routing. The selection of the algorithm for laying out the route is one of the basic problems in developing a communications network with packet communications. Of special interest are adaptive routing methods which make it possible to take into account the current network topology and the loading of the communications channels dynamically. These methods include various modifications of the topography method used successfully in many networks with packet switching [1-3, 6] . The shortcoming of such methods is that with an increase in the number of junctions in the network, there is an increase in the volume of the routing tables and the time needed to transmit packets of route renewals. The problem of adaptive routing for large networks may be solved by combining data, to be sent to remote junctions, and design multilevel routing tables. In this case, the network junctions are combined in groups of various levels. A group of level m contains some number of groups of level $m-1$. If the number of levels in the network is M , while the maximum number of components in the group is n , then it is necessary to have M routing tables in each KP with each of the tables containing not more than n inputs.

An adaptive routing algorithm is used in the UPKP with a number of levels $M = 2$ (junction-region). Therefore, each junction has two routing tables. If adjacent junctions belong to the same region, the processing of route renewal packets is done in the same way as for single-level routing. If, however, the junctions belong to different regions, the data in the first table is combined with the line of the second table.

Fig. 3 shows the renewal of the routing table for junction 1.1 of region I when a routing renewal packet is received from junction 11.1 of region II. In this case, data on junctions 11.1 - 11.3 is combined into one line that determines region II in table of junction 1.1.

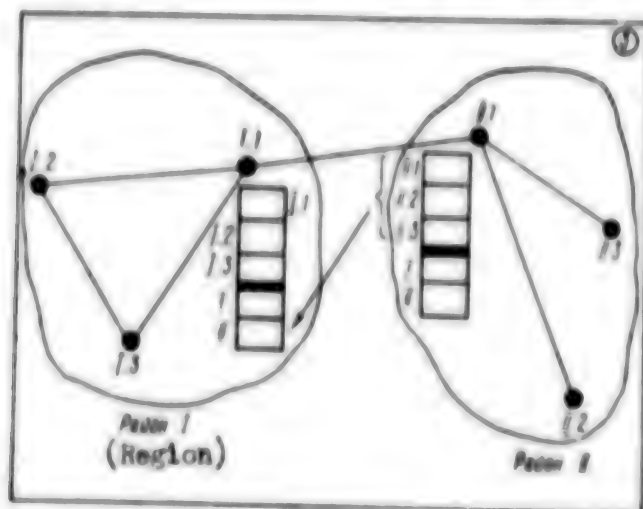


Fig. 3. Table renewal for two-level routing

Data channel control. The protocol for controlling the data channel determines the formats of the data transmitted over the physical communications channel between two computers (stations) and the actions of the transmitting and receiving sides in various situations that may originate with their joint operation, including the action on detecting and correcting errors.

The protocol selection is closely related to the apparatus used for data transmission. For asynchronous apparatus of intermachine communications, a protocol was implemented that uses algorithms and the terminology of the standard for procedures of line control HDLC, developed by the International Organization on Standards [1, 7]. The HDLC is a set of procedures spanning various line configurations and operating modes (duplex and semiduplex, two-point and multiple-point communications, etc.). A procedure subset was selected in the

described system oriented toward a semiduplex operating mode, which is determined by the semiduplex apparatus used for transmitting the AMS data.

According to the HDLC protocol, the data exchange over the channel and error correction are controlled by one of the stations, called primary, and frames sent by it are called instructions. The other station is the secondary station and transmits responses. NRM establishes that the secondary station can begin transmission only after permission is received from the primary station. The response transmission may consist of one or several frames, the last of which is recorded by the secondary station. The data channel determined in this manner is asymmetrical, which makes it difficult to use for data exchange between KP having equal rights. To overcome the indicated asymmetry in the program implementation, it was assumed in the UPKP that each station may fulfill either primary or secondary functions and that its status is established after establishing the logic connection between the two stations.

Depending upon the content of the control, field frame formats are divided into informational, supervisory and unnumbered (see Table).

After a frame is transmitted by the primary or secondary station, time-out TI (five seconds) is counted off. If, before the end of the time-out, the frame with the correct monitoring sum is not received from the opposite station, the transmission is repeated (not more than seven times).

Table

Set of instructions and responses

Frame formats	Instruction	Responses
Information	I (informational frame)	I
Supervisory	RR (ready to receive)	RR
	RNR (not ready to receive)	RNR
Unnumbered	SNRM (establish mode of normal responses)	UA (unnumbered confirmation)
	DISC (disconnect)	CMDR (instruction rejected)

A type BSC protocol was developed for synchronous apparatus oriented toward transmitting data byte-by-byte. In the type YeS processing computer, this protocol is implemented by means of the basic telecommunications access method for a point to point synchronous channel. Both stations participating in the exchange have equal rights. The exchange process is represented as a series of sequential stages: 1) establishment of logic linkages; 2) transmission of data; 3) logic disconnect. The data exchange is done in an obvious mode, i.e., the frame text may contain any code sequences.

To control the data flow in the channel, the informational frames are supplemented by the controlling byte which contains the indication of the presence of receiving buffers on the transmitting side (credit) and the indication of the presence of text in the frame. If the latter is zero, then the frame contains only the controlling byte. Credit equal to zero is interpreted as a requirement of a temporary delay in the transmission of the informational frames. A sequence of API controlling symbols may be used for this purpose. This requirement will be removed when the delayed station receives credit greater than zero.

The following symbols are used in the protocol for control: KTM -- establishment of logic linkage; SIN -- synchronization; NT -- start of text; KT -- end of text; KP -- end of transmission; DA -- confirmation; NYeT -- negative response; API -- input into obvious mode; API -- requirement of data transmission delay.

The cyclic monitoring sum of the informational frame is calculated by the apparatus. In this case, the same generating polynomial is used as in the previous procedure. A comparison of the efficiency of the described procedures is given in paper [8].

KP software. The development of KP using minicomputers required the creation of a specialized control program for the KP and auxiliary programs that make it possible to utilize the apparatus and software facilities of large computers to develop software.

The UPKP includes the following components: process control (UPKP nucleus) -- 1.8K bytes; packet switching -- 0.4K bytes; routing -- 0.7K bytes; communications lines control -- 4K bytes; programs for service processes (TELETAYP, BCHO, OTLADKA, STATISTIKA, FON, etc.) -- 3K bytes; initiation -- 0.5K bytes.

Process control. The KP operation is presented as implementing a set of parallel processes in the real time mode. The UPKP utilizes all the resources of the minicomputer (memory, central processor, communications channels), separated by the totality of the parallel processes.

A semaphore mechanism was implemented for process control [6]. Binary semaphores and data semaphores are utilized. The binary semaphore implements P-operation (capture resource) and V-operation (release resource). The data semaphore implements the DP-operations (obtaining a resource unit) and the DV-operation (freeing the resource unit). Each process is assigned two areas of memory: an area for temporary storage of data (drain) and the process control unit. The number of processes is fixed. Several process conditions are differentiated: current, active, waiting at the binary semaphore, waiting at the data semaphore, delays to the expiration of the time interval.

The control of the process sequence is based on an asynchronous strategy with priorities [6]. In this case, the current process is always the one of the active processes that has the highest priority. In descending order, the priority processes are located as follows: 6 -- process of receiving and transmitting frames; 5 -- synchronous process; 4 -- dump packets; 3 -- switch, 2 -- routing; 1 -- service processes; 0 -- background noise.

One basic resource of the KP is the direct-access memory unit, whose free part is divided into fixed length units (284 bytes) linked in a list of free units (buffers). Access to the buffer memory is implemented through the data semaphore. If there are no free units, the process that implements the DP-operation by this semaphore is changed over to the waiting state and is placed into one of the six lines of the waiting process (depending on its priority).

Another resource of the KP used by all processes is the central processor. The KP has six lines of active processors (for the number of priority levels) in which processes may be located which are waiting for the freeing of the central processor. Each line is served on a first come-first served basis. The lines are scanned in the order of their priorities. If all lines of active processors are vacant, the background noise process is implemented.

To provide temporary relationships, the KP has a line for delayed processes ranked in accordance with the time of initiation. The current process is changed over to the waiting state and placed in this line by a call from the delay subprogram. The program for processing interruptions by the timer scans the line of the delayed processes and changes over those processes whose delay time expired into the active state. The delayed process may also become active as a result of a call by the current process of the activation subprogram of delayed processes.

Packet processing. The packet is received in the direct-access memory unit of the KP by one of the input-output processes the number of which is equal to the number of communications lines connected to the KP. The input-output processes are implemented by reentry programs realizing that or another protocol of informational channel control.

A buffer for packet reception is selected from a list of free buffers. If no free buffers are available, a short buffer assigned to each input-output process is used. As a result of the static assignment of the short buffer, the input-output process may accept a packet from the adjacent KP. If this results in overfilling a buffer, the accepted packet will not be processed and its reception will not be confirmed. The short buffer is also used to transmit control data (confirmation, requirement of transmission delay, etc.).

A packet received without errors is placed in the line of the switching process whose problem is to select one of the output lines for further packet processing. This may be an output line to one of the adjacent KP, to the AVM or to a service process of a given KP. Routing tables, dynamically renewed by the routing process, are used to select an output line. If the packet cannot be delivered to the addressee, it is destroyed. In this case, a diagnostic packet with the text of the packet containing the title of the initial packet and the error code may be sent to the sender.

Service processes. Service processes in the KP implement a number of functions. A part of the address space of the network is used for naming them, thus, they may be used by packet senders and receivers.

The TELETAYP process provides communications with the KP operator. The latter may form a packet and send it to any addressee of the network. In forming the packet, it is possible to indicate what conversion must be made on the introduced text. For example, the packet text may be interpreted as a record in a sexadecimal form.

The EKHO process reflects the obtained packets and forms loop-shaped routes. By using EKHO jointly with TELETAYP, it is possible to check the accessibility of some junction in the network.

The OTLADCHIK process makes it possible to check and, if necessary, to change the content of some area in the KP memory. These actions are done on instruction received from the TELETAYP (operator) process of the given KP.

The function of gathering statistical data on the KP operation is implemented by the process -- instruction processor and two processes by sender of statistical data. The instruction processor receives packets whose text contains the instruction which determines the statistical data receiver, the period of their formation and sending, and the composition of the statistical data being transmitted. The processes --

senders of statistical data operate with time-outs determined by the received instruction. Records on the lengths of the lines with period T_d are formed in the KP, and records on traffic (number of transit packages, number of repeated transmissions, volume of traffic between KP and AVM, etc.) and loading of the central processor of the junction are transmitted. The instruction may contain the tracking mode according to which is formed the service packet containing the time of arrival, the line number and the length of the received packet.

An additional means for tracking the condition of the communications subnetwork is by utilizing the service field in the packet title. Including the routing in the bit unit causes the formation and sending of special routing packets to the address of the sender of the initial packet; the title of the initial packet and the time of its stay in the junction is recorded in these special packets. Routing packets are sent from each intermediate KP along the route of the initial packet. Another variation of routing provides for the inclusion of the indicated data in the text of the initial packet.

Fixed routing may also be used to create checking modes in the network. In this case, the packet route is contained in its text.

The possibilities of controlling the operation of the communications subnetwork presented by the service processes are intended for use by the developers and the network administration. Special protective measures were adopted to prevent unsanctioned access to them.

Evaluation of transit capacity. By transit capacity of KP, we will understand the number of data bits that pass through the processor per unit time:

$$P = k \frac{I}{T}, \quad (1)$$

where I -- length of the informational field of the packet in bits;
 T -- average time required for receiving, processing and transmitting one packet to the adjacent KP and receiving a confirmation; k -- coefficient that takes into account that part of the KP transit capacity which is used for providing periodically passing processes such as processing timer interruptions and the renewal of routing tables ($k < 1$).

Time T includes processing the packet by the KP program and processing the interruptions by the apparatus when receiving and transmitting:

$$T = T_{pr} + T_a. \quad (2)$$

This time depends on the adopted protocol for controlling the informational channel and on the method for connecting the line adapter (direct access to the memory unit or program controlled data transmission). Below is given an evaluation of the transit capacity

of the KP for an NDLC type protocol, implemented by a program using asynchronous apparatus of intermachine communications.

The time of program processing T_{pr} is determined by the total number of instructions implemented during the passage of the packet through the KP and by the average time of implementing one instruction

$$T_{pr} = T_1 + T_c + T_o, \quad (3)$$

where T_1 -- operating time of the packet receiving program; T_c -- switching time; T_o -- operating time of the program for transmitting the packet in the communications line.

In connection with the byte-by-byte exchange between the KP and the line adapter, the packet receiving-sending time depends on its length and speed of processing the interruptions:

$$T_1 = [n_1 + n_{bl} (I + H + F)] t, \quad (4)$$

$$T_o = [n_o + n_{bo} (I + H + F)] t, \quad (5)$$

where n_1 -- number of instructions in the packet receiving program; n_{bl} -- number of instructions in the program for processing interruptions when receiving a byte; H -- length of the packet title; F -- length of framing the frame (initial and final markers, monitoring sum, address and control fields); n_o -- number of instructions in the program for transmitting the packet; n_{bo} -- number of instructions in the program for processing interruptions when transmitting the byte; t -- average time for implementing one instruction.

The switching time depends only on the length of the switching program:

$$T_c = n_c t. \quad (6)$$

Finally, the total time for processing the interruptions by the KP apparatus when receiving and transmitting the packet is equal to:

$$T_a = 2(I + H + F) t_r,$$

where t_r -- reaction time of KP apparatus to interruptions.

By the transit capacity of a communications channel, we will understand the number of bits transmitted over the channel per unit time. In this case, not only the informational bits of the packet, but also bits in the title and for framing the frames are taken into account:

$$S = P + \frac{H + F}{T}.$$

Fig. 4 shows the theoretical relationship between the KP transit capacity and the processing time and the length of the informational part of the packet. This relationship was calculated on the basis of expressions (1) - (7) for parameter values; $H = 144$ bits, $F = 36$ bits; $t = 5 \times 10^{-6}$ sec; $t_r = 6 \times 10^{-6}$ sec; $n_1 = 550$; $n_{b1} = 16$; $n_0 = 350$; $n_{b0} = 26$; $n_c = 80$; $r_k = 0.95$.

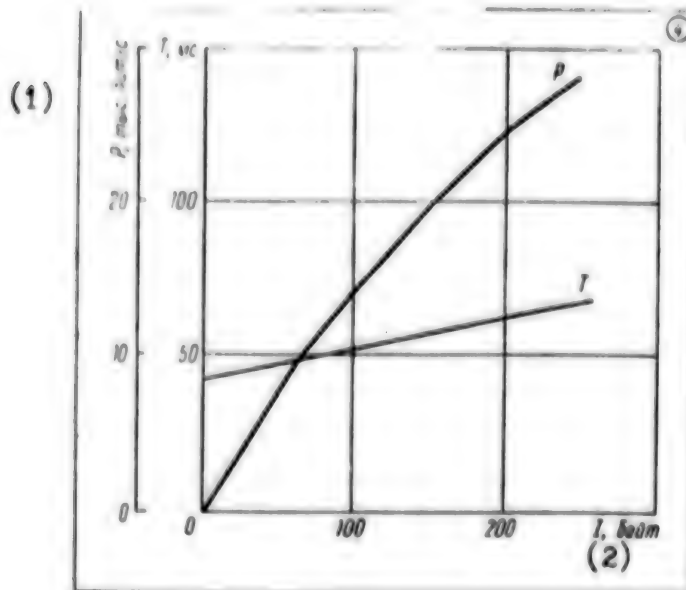


Fig. 4. Relationship between KP transit capacity and time for processing the packet and the length of the informational field.

1. thousands bits/ sec

2. bytes

For a packet 200 bytes long, this calculation gives a value for the transit capacity of the KP $P = 24,700$ bits/sec or approximately 15 packets/sec. An analysis shows that by using line adapters with direct access transit capacity increases by about an order of magnitude.

The following experiment can be made to measure the actual transit capacity of the KP.

The output of one of the two communications channels of the KP is connected to the input of the other one and a packet is directed to the formed loop. A process for gathering statistical data is connected to determine the load of the central processor. The actual transit capacity of the KP can be determined as

$$P_b = L \frac{T_s}{T_s - T_w},$$

where L -- speed of communications channel; T_s -- time interval to and from the moment of the end of the experiment; T_w -- total idle time of the central processor during interval T_s .

Conclusion. The developed variation of the KP that provides for a datagram interface with a type YeS subscriber computer may be used to create experimental computer networks with packet switching and for making the necessary studies for designing a government network of computer centers. Several directions for the further development of KP may be outlined.

1. Provide local communications with type YeS computers through a device for coupling USVM A711 computers.
2. Use high speed communications channels with up to 48K bits/sec.
3. Use adapters that implement part of the functions of the HDLC protocol.
4. Improve the routing algorithm for large networks.
5. Develop apparatus and software for connecting machines of other types, for example, the BESM-6, to KP subscriber.
6. Increase KP functions for implementing the transport protocol and the protocol of a virtual terminal in the subnetwork of data transmission.

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ONE APPROACH TO DESIGNING INTERFACE CONTROL LOGIC

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 6, 1979
pp 92, 94, 95, 96

[Article by A. V. Skurikhin]

[Excerpta] The use of microprocessors to design input-output controllers has undoubted advantages [1]. However, for those peripheral devices for which the great possibilities of microprocessors are superfluous, as well as for other reasons, such as economic [2], it is necessary to design interface modules using average and small degree integrated circuits. If microprocessors were fast enough, then all the interface control logic could be programmed [2], but the interface control logic in the computer channel, as well as in the controller cannot be fully programmed because of the rigid requirements of temporary relationships at the interface. Instead of storing the program that determines the signal sequence at the interface, it is necessary to form these sequences by means of triggers and coincidence circuits in the memory device. A logic designed in this manner has an irregular structure and the presence of isolated circuits for forming delays (DELAY) [3], creates difficulties in manufacturing and debugging.

One widely used approach makes it possible to change the sequence of the microinstructions of the controller depending upon the external signals using a conditional transition type of operation. The implementation of such an operation is related to the fact that the address of the following instruction is determined by the code of the initial instruction, if the condition, selected by the code of the initial instruction from a series of existing conditions at the given moment in the register, is fulfilled. An analysis of bits in the conditions register is made by a multiplexer, whose address inputs are controlled by a special field of the microinstruction [4]. If the multiplexer output is connected to the input of the low order register of the microinstruction address, the address of the following microinstruction may be even or odd depending upon the condition. This approach makes it possible to change the transition code conditionally

which determines the address of the following microinstruction. If one of the microinstructions is forced to address itself, a delay of some external event, related to the change of conditions contained in the register [4] , may be organized. The use of the enumerated possibilities for designing interface control logic involves a complicated processing of controller operations at the interface and delays in signal sequences at the interface due to the fact that the fulfillment of each action in turn is connected with reading the following microinstruction from the memory.

The proposed approach is directed toward eliminating the irregularity of the interface control logic and increasing the efficiency of the controller by apparatus implementation of an algorithm for organizing communications with the computer channel. Its essence is that a regular structure, that takes into account the special feature of the medium degree of integrated circuits, is used to design the interface module that does the functions of the interface controller. The transition from the structure to the schematic diagram of the interface control logic is made by proposed rules that determine the switching order of the part of inputs and outputs within the initial structure. The switching rules must formally approximate the process of the control logic design to the process of locating the microinstructions in the memory of the controller and thereby make the apparatus part accessible to a degree that would be possible only with fully programmed logic.

In spite of considerable limitations which are imposed by the fixed structure of the module on the coherence of the algorithm realized by it, the proposed approach has flexibility which is demonstrated graphically in the example of the realization of a popular [3, 6] algorithm, determined by a sequence of actions of a group controller when communications to a computer channel are organized for fulfilling the input-output operations. If the apices of the block diagram (Fig. 3) [not shown] are located in the location table (Fig. 2) [not shown] and the switching is done by using the above-cited rules, the structural circuit changes into the block diagram by replacing each structural unit by one or several design units of a widely used series of integrated components. For example, Dskh-K155103, SchKh-K1551Ye7, HpKh-K155KP1, RgKh -- KM155TM5, Sdkh-K155LA2. A part of the coder that suppresses the signal SchKh1 = AdKh operates as a coincidence circuit. The parts of the coder that enter the code into the registers operate as four division circuits.

In conclusion, we will note that part of the cited results may be considered as an independent method for designing automated digital machines. However, limitations on the coding states of such an automated machine and the feasibility of its use in the exceptional case

of realizing a microprogram with a great number of transitions, in which the condition of independence of input and output signals is not fulfilled (which is characteristic of the interface), eliminate the importance of such an independent method.

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REALIZATION OF SYSTEMS NOT FULLY DETERMINED BY BOOLEAN FUNCTIONS ON BASIS OF LOW AND MEDIUM LEVEL INTEGRATED CIRCUITS

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 6, 1979 pp 97, 103

[Article by A. A. Butov]

[Excerpts] Hybrid circuits are a wide class of circuits used in practically all discrete devices. An analysis of modern and newly developed computers indicates that the structure of hybrid units become more and more complicated. At present, in designing hybrid circuits, low level integration, as well as 4-, 8- and 16-channel multiplexers are used, while the latter are used only for a direct purpose such as switches. Meanwhile, multiplexers have large functional possibilities and may be used in the synthesis of hybrid circuits as components for realizing the decomposition of the Boolean functions and as universal logic modules.

The block diagram of a multiplexer is shown in Fig. 1 [not shown]. The multiplexer contains π controlling and 2^N data input poles while, when some binary set is delivered to controlling input poles $B_1, B_2, \dots, B_n$, one of the data input poles $A_0, A_1, \dots, A_{2^n-1}$ is connected to output pole D of the multiplexer. Fig. 2 [not shown] shows a representation of conventional multiplexers manufactured by the electronic industry in the form of medium integrated circuits of the K133 and K155 expanded series of microcircuits.

The synthesis method of hybrid circuits described below is a development of Shannon's method [1] and Povarov's cascade method [2] and makes it possible to realize system $F = \{f_1, f_2, \dots, f_m\}$ not fully determined Boolean functions depending on variables $X_1^m, X_2, \dots, X_n$, by a logic network of multiplexers and low level integrated circuit components.

In conclusion, we will note that the method of hybrid circuit synthesis described in this article was used as a basis of a series of algorithm

synthesis distinguished by the high speed and quality of the obtained solutions, as well as by the parameters of the component basis. The synthesis algorithms are written in the LyaPAS-M language [6] and were debugged in the BESM-6 computer.

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2291

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MINIMIZING THE AREA OF LARGE-SCALE INTEGRATED CIRCUITS IN THE
SYMBOLIC METHOD OF DESIGN

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 6, 1979 p 107

[Article by V. P. Rubtsov, A. M. Abbasov]

[Excerpt] This article considered one of those urgent and difficult to formalize problems of designing BIS [Large-scale integrated circuits] such as minimizing the area of the chip. In this case, the minimization of the BIS chip area was done dependent upon the selection of a basis used in the automatic design of the TCh

Topological drawing [BIS.] The given problem was divided into two independent problems. One of them was reduced to a mathematical programming problem and was solved as a system of linear algebraic equations, while the other -- to the minimizing of the piecewise-linear function of one variable.

Programs that implement the solutions of the indicated problems make it possible to automate the design process of the topological basis and grid, furnishing the designer with a calculating tool and a method for evaluating the efficiency of the basis he proposes. Work is being done on integrating these programs in a system of automated design of BIS by the symbolic method (SIMPAS) in the version for the BESM-6 computer.

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2291

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MEMORY MODULES USING MDP BIS -- BROAD USE COMPLEMENTING PRODUCTS

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 6, 1979
pp 108-112

[Article by V. I. Selivanov, V. Ye. Khavkin]

[Text] The continuous expansion of areas of application of the ZU [Memory device] determines the great variety of requirements demanded of memory systems for various purposes. The traditional approach to designing a ZU, consisting of creating specialized memory units for concrete computers, involves great amounts of labor and money for the design of circuits and equipment, developing the structure, technology and monitoring-measuring equipment, as well as for organizing small-series production of each ZU type. These costs, as applied to relatively small series, increase the production costs of the ZU by several tens and even hundreds of percents.

Another approach is possible -- develop and produce ZU modules in the form of completed products intended for direct use with computers and other devices for discrete data processing such as submodules of an expanded memory system or as an independent ZU. This way of satisfying a considerable part of the requirements for memory devices is especially feasible when changing over to the use of semiconductor ZU. It is assumed in this case that memory modules are developed and manufactured at enterprises that develop the BIS [Large-scale integrated circuits] ZU.

The stated proposal may be confirmed by the following:

the organization of series production of memory modules eliminates the necessity by users to spend labor and money on developing and assimilating small series of ZU with similar parameters at a great number of enterprises;

the systematic approach to design at all development stages (from components to the finished device) makes it possible to obtain the optimal result from the standpoint of minimum cost for the maximal area of application;

simultaneous development of BIS and ZU modules minimizes the development, assimilation and use of the modules in the user systems;

ZU characteristics may be improved by creating control integrated microcircuits;

standardized apparatus and methods for monitoring BIS and ZU modules reduce the cost of monitoring and increase its authenticity;

The lack of experience in developing ZU using MDP [expansion unknown] BIS by most users, as well as the emergence of a broad circle of users who, in general, do not have experience in designing high-speed memory devices, lead to considerable expenditures for developing ZU, not excluding also the possibility of not obtaining optimal results.

These considerations provide a basis to conclude that the development and series production of ZU modules using MDP BIS makes it possible to combine most fully the interests of the manufacturer and user with general government problems of raising the quality and efficiency of developments and reducing the time until their introduction.

However, the organization of production of ZU modules is economically feasible only if there is a sufficiently large market available, therefore, the development of ZU, not intended for concrete computer, must be preceded by a market survey of possible areas of application from the viewpoint of developing requirements for ZU parameters that would make them acceptable to the widest group of users.

The market survey indicated that at the present stage of semiconductor technology, ZU using MDP BIS has the greatest effect in the following areas of application: mini-and microcomputers, systems for controlling technological processes, data transmission processes, monitoring-measuring apparatus, displays, peripheral equipment for computers, etc.

To satisfy these areas of application, an OZU [expansion unknown] module using MDP BIS was developed and introduced in series production with the following technical characteristics:

Data volume, words	2048
Word length, binary units	18
Access time, microsec	2.0
Physical volume, dm ³	2.0
Weight, kg	1.5
Power used at maximum frequency of accesses, watts	14
Power consumed while stored, watts	5.3
Nominal feed voltages, volts	+24, +5 + 3
Input and output signal	TTL [expansion unknown] levels
Temperature range	0 to +50°C

The circuit of the OZU module is shown in Fig. 1. The data storage is designed by using dynamic OZU microcircuits type K535RU1 with a data capacity of 512 bits (512 x 1). The time diagram of input and output signals of the module is shown in Fig. 2.

The circuit for connecting the BIS OZU with 12-channel MDP transistors to power supplies and control circuits is shown in Fig. 3. This circuit eliminates the necessity of converting signal polarities and makes it possible to use simpler and more efficient circuits for amplifying input and output signals with simultaneous transformation of their levels. KINT251 microcircuits, discrete resistors and diodes are used in the circuits of amplifiers-transformers, but they are developed taking into account the possibility of their use in the form of bipolar integrated circuits.

The cycle pulse oscillator was made with KIPM561 microcircuits. The cycle pulse amplifiers (feed phases) were sectionalized so that one set of three phase amplifiers serves 18BIS OZU, taking into account the high capacitive load and the more rigid requirements of the pulse fronts (50 to 70 nanosec).

Signal amplifiers of the address code, the number and execution instructions are similar to the phase amplifiers but, to save energy, they are made with high load resistors in the load circuit of the first stage and are gated at the TTL-rectifier input.

Since the OZU modules were developed for as wide group of users as possible, in designing the device for regeneration control, the possibility was taken into account of operating with various modes of regeneration. In the access tracking mode, pauses between addressing are used for access to regeneration, if data read-out or entry are not made in the OZU in every cycle. If, during each storage period T_s , there are detected at least 32 pauses, there is no busy signal. If, however, there are less than 32 pauses during this period, there is a busy signal for a number of cycles that are a supplement of the number of pauses up to 32.

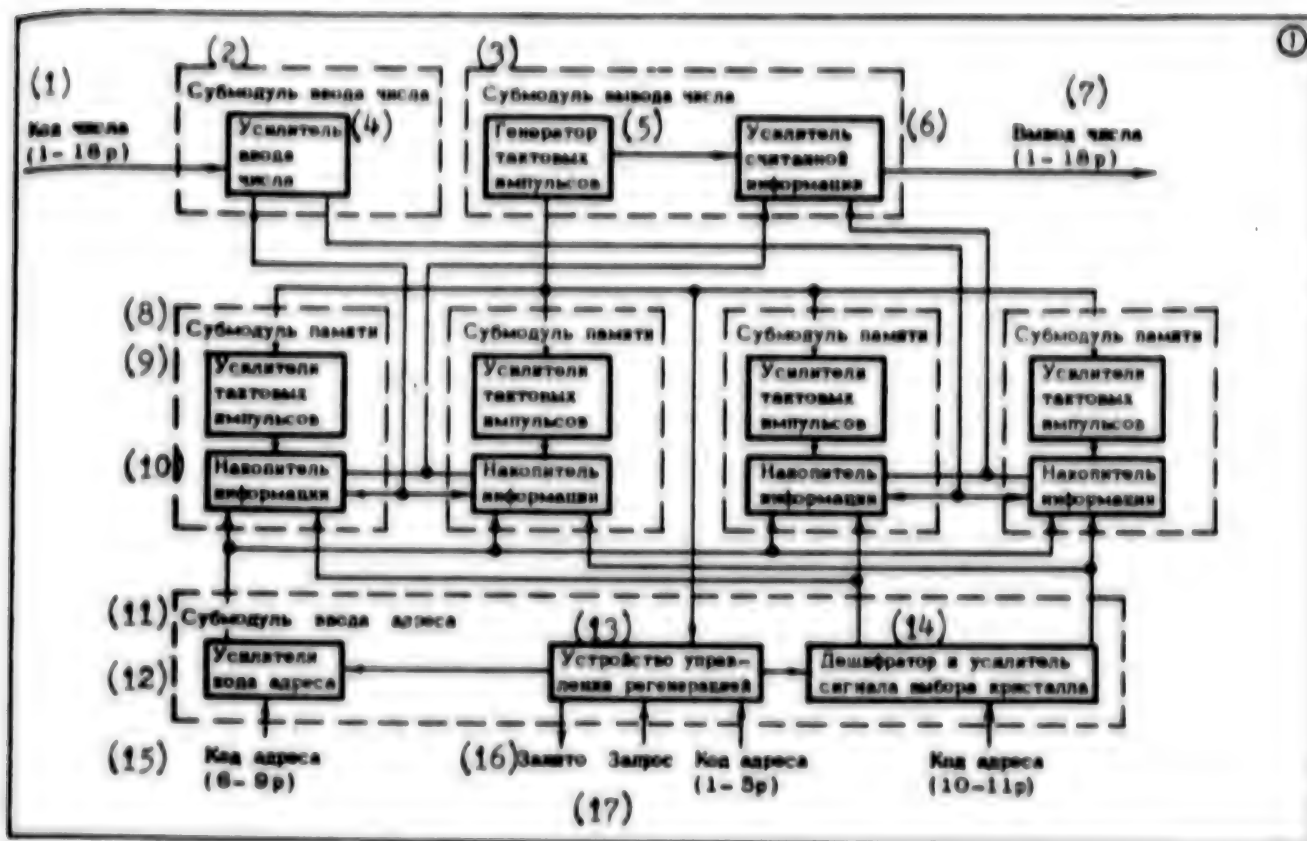


Fig. 1. Block diagram of the OZU using MDP BIS.

- | | |
|--------------------------------|---|
| 1. Code of number (1-18 rows) | 10. Data storage |
| 2. Submodule for number input | 11. Submodule for address input |
| 3. Submodule for number output | 12. Address code amplifier |
| 4. Amplifier for number input | 13. Regeneration control device |
| 5. Cycle pulse oscillator | 14. Decoder and amplifier of chip selection |
| 6. Amplifier of read-out data | 15. Code address (6-9r) |
| 7. Output of number (1-18r) | 16. Busy |
| 8. Memory submodule | 17. Interrogation |
| 9. Amplifiers of cycle pulses | |

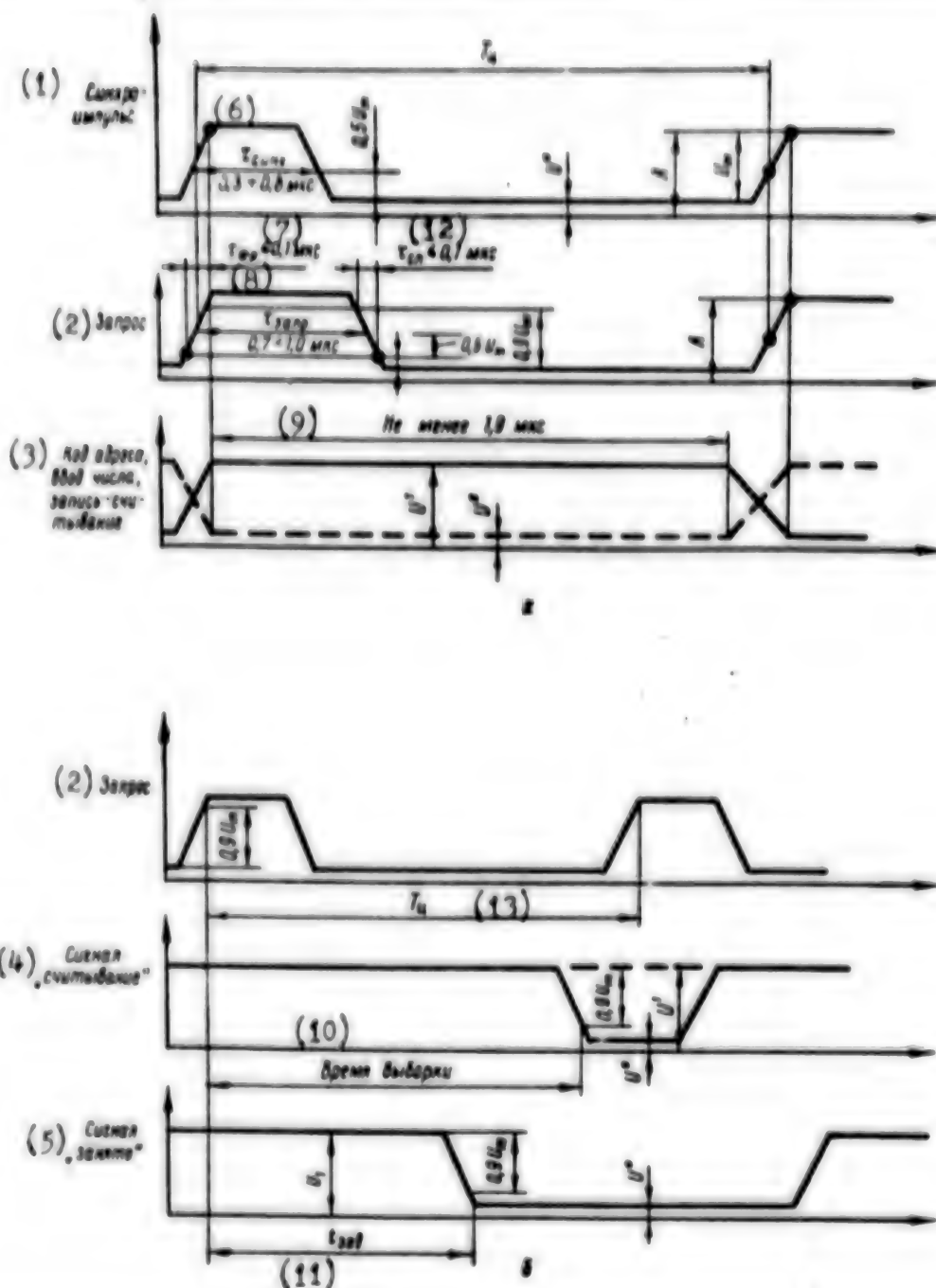


Fig. 2. Time diagram of the OZU: a -- input signals; b -- output.

- | | |
|--|---|
| 1. Synchronous pulse | 7. $\tau_{fr} \leq 0.1 \text{ microsec}$ |
| 2. Interrogation | 8. τ_{inter} |
| 3. Code of address, input of number, recording, read-out | 9. Not less than 1.9 microsec |
| 4. Signal "read-out" | 10. Selection time |
| 5. Signal "busy" | 11. t_{delay} |
| 6. τ_{sync} | 12. $\tau_{sp} \leq 0.1 \text{ microsec}$ |
| | 13. T_{ts} |

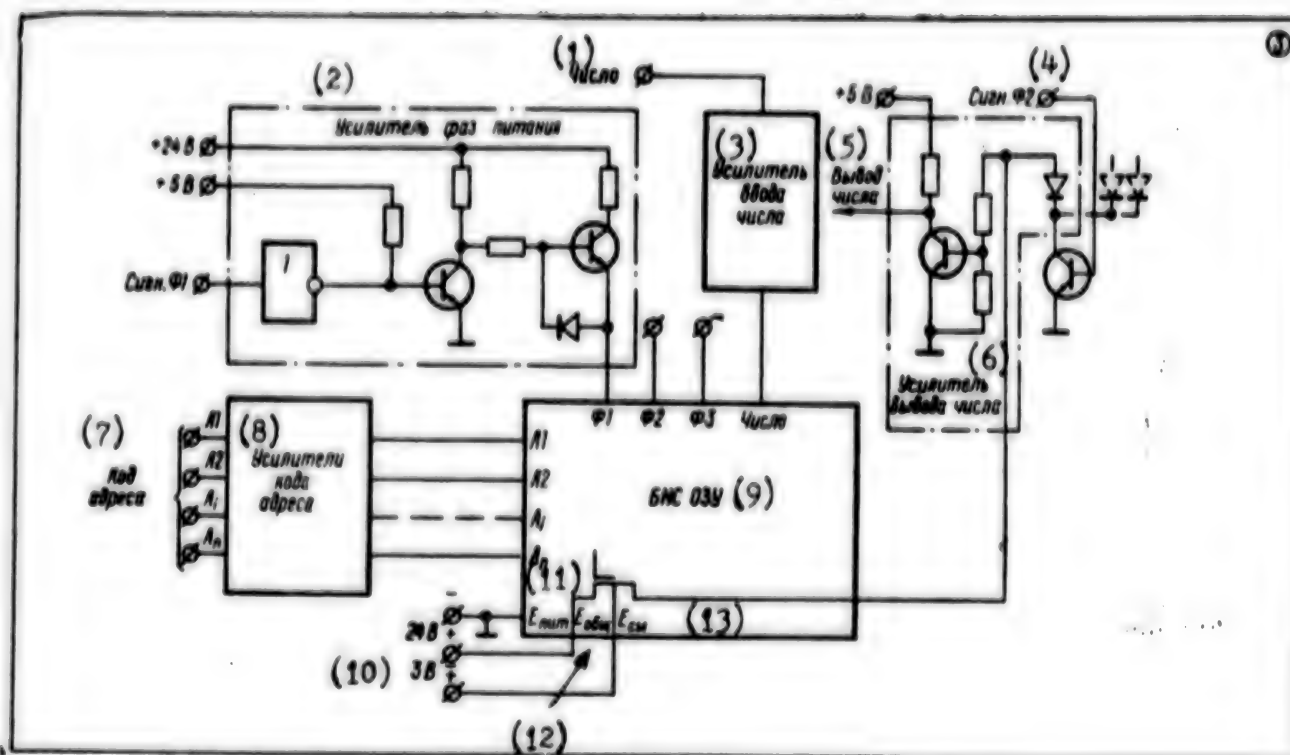


Fig. 3. Circuit for connecting BIS OZU to sources of dc and pulse feeds.

- | | |
|-------------------------------|-----------------------------------|
| 1. Number | 8. Amplifiers of the address code |
| 2. Amplifier of feed phase | 9. BIS OZU |
| 3. Amplifier of number input | 10. 3 volts |
| 4. Signal F2 | 11. E feed |
| 5. Number output | 12. E_{gen} |
| 6. Amplifier of number output | 13. E_{sm} |
| 7. Address code | |

The appearance of a busy signal at the OZU module output is a warning of the necessity of sending in the following regeneration cycle data along one of the rows and on inhibiting, in this connection, access to the OZU, over an external channel. In this case, the following interrogation of the ZU must be delayed by one cycle of the synchronous pulse. For continuous accesses to the memory at a frequency equal to the synchronous pulse frequency, the busy signal appears every seventh cycle; at a lower frequency of access, it may not be produced at all.

In the address tracking mode, row addresses to which accesses were made during $T_1/2$ are stored. If, during that time, all rows were selected even once, there is no busy signal; if, however, not all rows were selected, regeneration is made only of rows not selected during the previous time interval. There is also the possibility of combining two regeneration modes.

Implementation of all these functions requires a great amount of electronic equipment. In order to miniaturize and reduce to cost of the regeneration control equipment, a K535RP1 microcircuit was developed and is used in the OZU module.

Its block diagram is shown in Fig. 4.

The functional composition of the OZU module determines its structural division into submodules. Each of the four submodules of the memory has a capacity of 1024×9 and contains 18 BIS and a feed phase amplifier. The ZU microcircuits are wired on both sides of a printed circuit plate that has a local gold-plated connector. The submodule for address input contains address code amplifiers, the regeneration control circuit, decodes and chip selection signal amplifier. To save space, all microcircuits are located on one side of the printed circuit plate, while all resistors and diodes -- on the other side. The submodule for the number output contains 18 read-out amplifiers and a cycle pulse oscillator, the submodule for the number input has 18 input data amplifiers.

The contact switching by seven 44-contact connectors, mounted on the module housing, is implemented by a special printed circuit cross-plate.

All submodules are placed in a common metal housing with three external type RS-19 connectors. The total size of the module is $145 \times 136 \times 105$ mm. All parts of the structure (brackets, guides, housing, jacket, etc) are made by the most productive technological methods: casting under pressure, stamping and pressing. A set of monitoring-measuring apparatus was developed for monitoring the module and its submodules in the process of manufacturing.

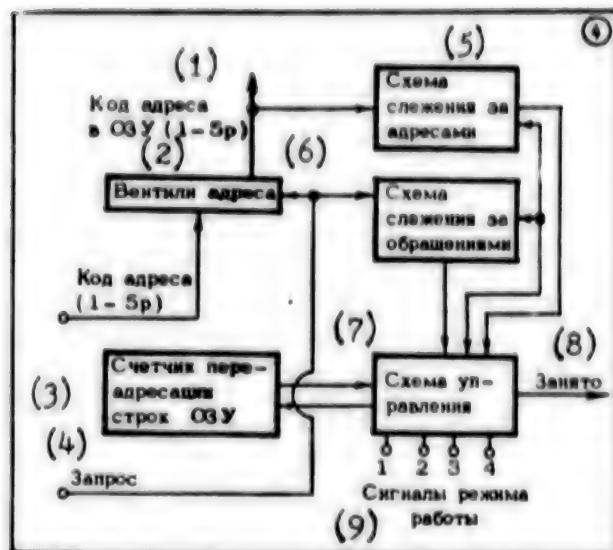


Fig. 4. Structural block diagram of the K535RP1 regeneration control microcircuit

- | | |
|--------------------------------------|----------------------------|
| 1. Address code in the OZU (1-5r) | 6. Access tracking circuit |
| 2. Address gate | 7. Control circuit |
| 3. Counter for readdressing OZU rows | 8. Busy |
| 4. Interrogation | 9. Operating mode signals |
| 5. Address tracking circuit | |

To insure high operating reliability, each module is subjected in the process of production, to a 100-hour high temperature run at increased power source voltages, as well as vibration tests. The limiting module tests made indicated considerable production reserves with respect to climate stability, mechanical strength and reliability.

Taking into account the fact that the data capacity and the digital configuration may be excessive for a number of applications, there is the possibility of supplying modules with a data capacity of 512 and 1024 numbers with words nine bits long in the same structural execution. When using the modules in systems with high data capacity and digital configuration, they are combined directly by the address and data busses or only by the address bus (in the case of an increase in the length of the word). In a system with a large data capacity, the module is selected by decoding the "interrogation" signal.

The correctness of the orientation of a previously selected group of users was confirmed in the process of series manufacturing and supplying the modules. At present, the OZU modules are being used successfully in machine tools with programmed control as an expandable memory for mini- and microcomputers, in monitoring-measuring equipment, medical apparatus, in data transmission systems, data displays, systems for technological process control, etc.

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2291

CSO 1863

ON DESIGN OF MULTIPLE-LINK SYSTEMS FOR AUTOMATING SCIENTIFIC
EXPERIMENTS USING ODA-20 APPARATUS

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 6, 1979 pp 117-118, 121

[Article by S. N. Zharovskiy]

[Excerpts] Systems for the automation of scientific experiments (ANE) being created and trends in their development involve combining a group of scattered computer objects and facilities into a single system. In this case, the distances between individual links of the system may exceed the possibilities of the parallel interface facilities considerably.

A natural way to overcome these difficulties is to use sequential data transmission on long sections over two or four-wire lines, making it possible to eliminate the mutual effects of the parallel circuits of the interface and reduce sharply the cost and operating expenditures of the communications lines.

Examples of systems that include combination means for joining, are the SAMAS system and the Hewlett-Packard standard interface [1, 2]. Not stopping at a detailed consideration of these systems and the facilities for sequential data transmission they contain, it should be noted that they are oriented to a parallel data exchange and their mode of sequential transmission is an auxiliary one and has limited possibilities. Based on the analysis of the existing ANE systems and the requirements of the designed systems, it may be concluded that it is necessary to include in their composition sufficiently flexible facilities of sequential interface that satisfy a number of requirements. However, ANE system designers, as a rule, encounter great difficulties when they select means for sequential interface because the available facilities for sequential data transmission are oriented either to communications between subscriber points and a remote computer, or to data exchange between computers and cannot provide efficient interaction between all ANE links.

Thus, the creation of facilities for a sequential interface for the ANE systems is an important and unsolved independent problem, at present.

One of the first domestic developments for this purpose is the ODA-20 apparatus created in the IK [Institute of Cybernetics] AN Ukrainian SSR [3].

The following problems were posed in the ODA development:

minimization of costs for creating data exchange networks in multiple link ANE systems;

use of existing intradepartmental telephone communications for data transmission;

organization of centralized and decentralized data exchange between various links of the system;

fulfillment of the functions of the center equipment control and data concentrator with the organization of intracenter data exchange;

provision of high noise resistance for comparatively low requirements for communications lines and maximal exchange speed;

organization of a number of exchange modes, taking into account the special features of complicated ANE systems;

provision for standard joining of the 2K rank to sources and receivers of data;

use the SEKTOR system, developed previously by the IK AN Ukrainian SSR [4] as a design base for technical facilities for communications with the object.

These problems are solved to a considerable extent by ODA-20 apparatus, whose parameters are given below:

Speed of data transmission (bit/sec)	1200, 4800, 9600, 19200
Volume of data packet (byte)	256
Method for protection against error	Orthocontrol by parity and decision feedback
Method for transmitting signals	Synchronous, by combining amplitude and relative phase manipulation
No of MKS (Multipoint channel communications)	Not over 20

Maximum length of communications lines 20km
No. of interface inputs of 2K rank [7].

By using the ODA-20 apparatus, it is possible to design data exchange networks on the basis of multipoint communications channels (MKS) formed over unswitched two-wire telephone communications lines. In this case, several points (up to 20) may be connected to the MKS and exchange data between themselves.

The ODA-20 apparatus is oriented for use at low-rank distributed subsystems for gathering and processing data, which are used widely in the ANE systems. Moreover, such solutions may be applied to low-rank subsystems of ASU [Automatic control system] , ASUTP [ASU for technological processes and other IVS [Data-computer system]] where it is feasible to use MKS.

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2291
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PROGRAM PACKET FOR PROCESSING EXPERIMENTAL DATA

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 6, 1979
p 121, 125

[Article by O. V. Bernatovich V. V. Litvinov, Ye. N. Podchasova,
V. Yu. Suslov]

[Excerpts] It is well known that when investigating the processes of behavior of a complex system by simulation methods, two approaches are widely used: situational and statistical modeling. While in the first approach, the result of the investigation is a trajectory of the system functioning, in the second -- it is the characteristics of the process of the functioning of the system.

The latter approach predetermines the necessity of including facilities for processing the experimental data by the simulation software. In the ALSIM-2 [1] simulating system, these facilities are represented by the STATISTIKA subsystem, which can function within the framework of the system, as well as in an independent mode in the form of a packet of applied programs for the OSYs [Operational system] Single system] [2]. In the system mode, the subsystem is considered as some class (terminology in [3]), the connection of which makes access possible to its problem part. In the independent operation mode, access to the packet is obtained by the control language through OS YeS instructions [4] or by a PL [Punched tape] program. Since the STATISTIKA subsystem in the ALSIM-2 simulating system is one of a number of subsystems of a problem nature, the following is required:

standardize subsystem organization;

change over from the algorithm to the problem level of interaction language with the subsystem;

simplify the tuning and retuning technology of the subsystem.

The developed packet passed experimental operation, was released to the Republic Fund for algorithms and programs and was introduced in a number of organizations.

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2291

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ORGANIZATION OF A DIALOG SYSTEM AND INTERPRETATION OF OPERATOR
INTERROGATIONS IN AUTOMATED SYSTEMS FOR THE CONTROL OF SCIENTIFIC
EXPERIMENTS

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 6, 1979 pp 125-
126, 129

[Article by V. M. Shul'meyster, M. S. Nakhmanson]

[Text] Making complicated spectral and diffractometric investigations which are used widely in scientific practice for determining the composition and properties of substances is based more and more on the use of automated apparatus systems (AAK). The apparatus system contains the apparatus itself that does the measurements, the control computer and a software system. At present, the M6000 ASVT-M control computer system and its modern modifications are used widely to create the AAK.

The apparatus system is an independent system that solves three groups of problems:

automatic control of the investigation process and gathering experimental data;

processing of experimental data;

input-output of data and interacting of the system with the investigator.

The optimal time mode for AAK functioning is the time division mode between control problems and computer and input-output problems. The software of such a mode provides for the necessary sequence of control, processing and input-output.

A special operational system (OS) was developed. It includes a real time supervisor (SRV), an input-output monitor and an interpreter of the interrogations of the investigator. The SRV serves as a dispatcher of control and computer problems, while the input-output monitor and the interrogation interpreter make it possible to solve problems on input-output data in the real time mode in the form of a dialog between the investigator and the apparatus system. An instructional type of language was developed for the dialog.

The specialized operational system was developed in the MNEMOKOD M6000 language and has a volume of about 5k bytes. The OS presents no special requirements for the completeness of the M6000 computer and may be operated with a machine without magnetic memories and with a minimal volume of direct access memory (32K bytes). The small volume of the OS permits the investigator to locate a considerable number of programs for apparatus control and data processing in the direct access memory. Software was developed on the OS basis for several series produced AAK: an automatic X-ray diffractometer for studying polycrystals [1]; a diffractometer with a coordinating detector [2]; and an X-ray electronic spectrometer. As shown by experience with these developments correlated in [3], the basic advantage of the OS compared, for example, to a considerably more powerful disc operational system in real time (DOS RV), is its economy. OS permits the automation of medium complexity apparatus using minimal ASVT-M machine facilities.

However, to create a highly complex AAK to store and process a large volume of experimental data (0.2 - 2M bytes or more), it is necessary to use a standard DOS RV M6000. The function of time dispatching in such a system is done by the DOS RV supervisor. In this case, it is expedient to include specialized operational systems residential disc problems in the DOS RV monitor and interpreter system, which makes it possible to utilize OS within the DOS RV for designing a dialog in the real time mode using a convenient instruction language.

The supervisor of the specialized operational system and the possibilities for its use in creating the AAK are described in detail in [4]. This article describes the structure and possibilities of the input-output monitor and the interrogation interpreter and considers the input instruction language for controlling the process of scientific experiment.

The operation of a number of AAK made in 1976-78 [1-3] indicated a high efficiency of the OS. Combining the processes of experimental investigation and data processing makes it possible to increase the productivity of the expensive apparatus by 30 to 50%. Automating the complex multichannel DARK-2.0 diffractometer [2], that operates in a real time mode, would be impossible without using OS.

The input language provides a convenient and flexible interaction between the investigator and the apparatus system. Learning the input language takes 1-2 days to two weeks, depending upon the complexity of the analysis made by the investigator.

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2291

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MONITORING AND DIAGNOSTICS OF A DISC SUBSYSTEM OF THE M4030-1 COMPUTER

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 6, 1979
pp 136-137, 138

[Article by A. V. Spirkov, A. A. Merzhvinskiy, Yu. M. Ozhiganov, V. N. Telezhenko]

[Excerpts] A disc subsystem in the input-output system of the M4030-1 computer can be heavily loaded when solving user problems when monitored by operational systems OS YeS [Operational system - Single system] and DOS ASVT [Disc operational system-Automated computer system].

The productivity and reliability of the M4030-1 computer, as a whole, depends on the reliability of the disc subsystem; therefore, the disc subsystem that includes the A3283 control device and a set of YeS-5061 memories has built-in devices for monitoring and diagnostics, as well as a set of functional and diagnostic programs that makes the operating process of the M403-01 system highly reliable.

Monitoring of transmitted data while implementing recording and read-out instructions is done by apparatus. This provides highly authentic data transmission from the channel to the magnetic tape and back.

Indication facilities and fault dictionaries in the monitoring and diagnostics disc subsystem make it simple to determine incorrectly functioning units.

The software of the A3283 control unit, unlike the apparatus of the A3281 included in the M4030 system, made it possible to use, besides apparatus monitoring facilities, diagnostic facilities for checking equipment A3283, YeS-5061 and YeS-5261.

Program and built-in facilities for monitoring and diagnostics of the disc subsystem of the M4030-1 system make possible an efficient search of faults in the A3283 control device, as well as in the memory made of interchangeable YeS-5061 magnetic discs. The diagnostic facilities include:

monitoring apparatus facilities;

microdiagnostic texts of the A3283 device;

microdiagnostic texts of the YeS-5261 packet surface;

program diagnostic text of the unit for communications between the A3283 device and the channel;

program functional test of the disc subsystem.

Conclusion. The experience in debugging and doing monitoring-preventive maintenance work on the disc subsystem of the model M4030-1 system indicates the efficiency of the monitoring and diagnostic facilities considered in this article. The comprehensive combination of external, built-in and program facilities for diagnostics in the disc subsystem provide for high reliability of the entire M4030-1 system. The development of new peripheral equipment and an external memory based on the electromechanical principle of the data carrier drive must be done on the basis of an extensive analysis of the realization of a complex of diagnostic facilities or its most important components. These components must be selected on the principle of realization, complexity and costs of a newly developed product.

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2291

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SOFTWARE

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SOFTWARE DEVELOPMENT FOR "DISPATCHER COLLECTIVE USE COMPUTERS"

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 6, 1979 pp 16,20

[Article by B. N. Pan'shin]

[Excerpts] Introduction. The software system for the "Dispatcher collective use computers" (DKP EVM) occupies the lowest level in the structure of software for the informational-dispatcher service (PO IDS) [1] of a computer network. The system implements the following functions: operational control of the computer resources; organization of efficient mutual interaction between users and the local computer system (VS) and network; control of informational-computer resources at the VTsKP [Collective use computer centers] .

Operating systems of modern computers contain special programs that make it possible, on the basis of programs and tasks, to organize their priority processing, providing for efficient loading of the processor and external devices. However, when the computer functions in the network (or VTsKP), the static determination of the request status, i.e., its class and priority, is not sufficient. There is a trend to change over to a dynamic distribution of the computer resources taking into account the concrete situation of the computer and the operational interaction (interface) between the user and the VS [2] .

In this sense, the DKP EVM software system is one form of organizing such an interface, supplementing the possibilities of the software system with such facilities of operational control and collective use of resources as organizing the order of passage of the input flow of tasks, coordinating the working load with the equipment possibilities, creating efficient mixtures from tasks received from the network and tasks of local packet processing, etc. The efficient solution of the indicated problems requires an operational evaluation of unloading VS resources, which is implemented on the basis of diagnostic and network measurements (measurements of characteristics of network operation) data. The operational formation of this data, as well as data on the degree of

utilization of the software require organizing DKP EVM communications with facilities for gathering calculation data in the operational systems (supplementing these facilities with functions of systemization) and accumulation of calculation and measuring data [3]. The implementation of these communications is the internal interface of the DKP EVM system.

Conclusion. In accordance with what was stated above, we understand that by the DKP EVM we mean a system of programs and data intended for automation of operational planning and control, and for providing a given mode of communications between the user and a local VS, functioning within the computer network. The considered DKP EVM structure is based on principles of universality and absolute values, is extremely simple, and may be standardized for various applications (for operational control of computer resources, monitoring the utilization resources of the VTsKP, as a base for creating specialized OS [Operational system] ASU [Automatic control system], etc. Introducing the DKP EVM into the software of the departmental VTs or VTsKP will make it possible to remove from the administration of the VTsKP and the dispatcher personnel of the ASU a considerable load of monitoring the utilization of computer resources and control of the interaction of program systems in complicated ASU. A division of the processing processes by the DKP EVM into user processes and service processes will make it possible to increase the reliability of the functioning of the entire system. The practical implementation of the subsystem of the operational control of computer resources and the calculation-measurement programs on the basis of OS YeS, which are at the present time at the stage of experimental operation, confirmed the correctness of the selected concept for the structure of DKP EVM software.

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2291
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BUSINESS GAMES IN THE TRAINING PROCESS

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian, No 6, 1979
pp 21-22

[Article by V. I. Rybal'skiy]

[Excerpt] Business games are called upon to facilitate the preparation for actual conditions of impending production activity. Six such games were developed and are being used in the Kiev Engineering Construction Institute. The largest of them is KROSS (Monitoring and regulating procurement and status of construction).

The game is intended for assimilating control habits by large construction complexes and programs at all levels, starting with the people doing the work and ending with the management of administrations and construction industries. As a result of playing the games, knowledge in the area of organization, planning and management, as well as ASU [Automatic Control System] obtained in lectures and practical (laboratory) work is fixed and consolidated.

The composition of the game participants, headed by several instructors, includes not less than 100 to 150 persons (four to six academic groups), who have studied problems of managing construction and using programming network methods adequately. Each group, under the guidance of two instructors, "erects" one complex consisting of three to four facilities, with the participants in the game having the functions of complex manager, members of a group for data processing (GOI) for the complex, managers of individual facilities and organizations, responsible executors of various kinds of work, and members of groups for network planning and control (SPU) at the facilities. A number of participants are occupied with the management of the system as a whole, including all the facilities being erected, as well as implementing functions of the data processing center (TsOD) for system management; and have the duties of managers of external organizations -- specialized

administrations and sections (sanitation, electric wiring and other work), plants of reinforced concrete structures, planning institutes, mechanization bases, etc.

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2291

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PROBLEMS OF AUTOMATING THE DESIGN OF DATA BASES

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 6, 1979 p 29

[Article by S. D. Mikhnovskiy, A. A. Stogniy]

[Excerpt] Data base [BD] is an organic component of modern control and data systems; the quality of these systems as a whole depends greatly on the results of its design. A more limited purpose than the BD includes is an automated system for data processing (ASOD) as a subsystem separated from the control and data systems. ASOD is represented by technical facilities, programs and unprogrammed procedures that provide storage processing and transmission of data within the framework of the general system. Due to the complexity of the problem related to designing the BD, the separation of the BD as the object of the design requires further structuring of the ASOD and of the process of its development.

The object under consideration in this article is part of the general process of designing the BD -- from forming the initial design requirements to designing its logic circuit. On the circuit for the design process of the BD (figure) [not shown], corresponding stages are outlined by thick outlines. It is assumed that the BD is created as applied to some completed system for the control of data bases (SUBD), while the selection of the most expedient type of the SUBD is one of the design stages.

The article gives an analysis of a number of well-known formulations of BD design and proposes correlating it to the level of designing of the so-called information-search subsystem (IPPS): this makes possible

a comprehensive evaluation of the entire totality of means spend on storing, renewing and searching data in the ASOD.

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2291

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SELECTION OF DATA FROM AUTOMATED DATA BANKS AND ITS OPTIMIZATION

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 6, 1979 p 41

[Article by G. G. Rastrugov]

[Excerpt] In recent years, many organizations in our country have simultaneously been carrying out developments of automated systems for storing and processing data called automated data banks (ABD). Judging by literary sources, the most varied approaches are used in these developments. Soviet, as well as foreign authors, devote their basic attention to the general structure of the ABD, its organization, location of data in the memory, etc. No less important, in our opinion, are problems of increasing the operational capacity of the ABD which was not given proper attention.

The operational capacity of the ABD, i.e., the possibility of processing the inquiry of the user within the necessary time is one of its basic characteristics since the ABD are created primarily to accelerate the processing of data. High operational capacity cannot be provided by increasing the operating speed of the computer without corresponding optimization of the ABD operation, for example, when processing economic data and for dialog modes of servicing.

The article considers one possible approach to the optimization of data selection from the ABD by using properties of the criteria system of selection.

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[278-2291]

2291

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USE OF FACILITIES FOR DEBUGGING SPECIFIC PROGRAMS FOR THE BROAD PURPOSE MICROCOMPUTER FAMILY

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 6, 1979 pp 51-56

[Article by M. P. Gal'pern, Yu. A. Maslenikov]

[Text] Developing facilities for debugging specific software (PO) for apparatus, devices and control systems based on broad purpose microcomputers [1] is one of the most important component parts of the comprehensive creation of microcomputers and their introduction in practice. This work includes: a) creating cross and residential facilities for automating programming; b) equipping microcomputers with program and equipment facilities for debugging and monitoring the progress of program implementation; c) developing principles for using various program and equipment facilities for debugging, oriented to systems of various complexity and to developers that have different organizational-technical levels of ability to use microcomputers.

Problems related to the development of facilities for automating programming for microcomputers were described adequately in [2-6]. Problems of designing apparatus-program facilities for debugging and monitoring microcomputer programs are very close to the problems solved for controlling previous generation computers. At the same time, due to various utilizations of the set of debugging facilities, developed for broad purpose microcomputers, questions of creating various class systems arise. Extensive communications with microcomputer users confirm the necessity of developing recommendations regarding the nature of using these facilities depending upon the experience of the developer of the control systems for computers and the development of apparatus using microcomputers.

Experience in creating control and data processing systems by using microcomputers makes it possible to formulate a number of basic requirements for debugging facilities for specific microcomputer programs:

debugging facilities must provide for automating programming and debugging of microcomputer programs by universal computers (cross-facilities), as well as the microcomputer itself (residential facilities);

facilities for automating programs must include, first of all, cross- and residential translators with the AVTOKOD type language, a loader and (for the cross-facilities) a modeling program of system instructions (MPSK) for microcomputers;

An interface must be provided between the microcomputer and a large control computer (or a junior model of one of the universal type) to create a debugging of the algorithms of the specific PO [7];

single-chip, single-plate and multiplate microcomputers must have (at least in the debugging mode) possibilities of monitoring program implementation and memory content.

The fulfillment of these requirements, directed toward obtaining maximal authentic data on the specific PO for realization in the microcomputer PZU [Permanent memory unit], led to the creation of a set of means for debugging specific microcomputer programs shown in Fig. 1 [not shown]. On its bases, we will describe possible stages in designing specific PO (Fig. 2) [not shown]. After developing algorithms of system functioning and after coordinating the circuit-program division of functions, the programming of the specific PO is done in machine language, assembler language and the high level language of the microcomputer.

It may be stated with assurance that developers of specific PO for microcomputers, when creating programs with a volume of more than 1K words, even in the first approach to the microcomputer, should not program in machine codes but in AVTOKOD. The convenience in modifying programs when debugging, even at the indicated volume, will pay for additional (compared to the study of the instruction system) assimilation of automatic programming facilities.

The next stage of design is debugging in specific PO by means of cross-facilities for automating program development. For broad-purpose microcomputers, these facilities, including an AVTOKOD translator, a loader and an MPSK, are equipped with universal computers BESM-6 and M220 of the Unified System. These design facilities make it possible to do the following:

develop programs in parallel with the creation of the apparatus framework for the system and its interface with the microcomputer in a mock-up model or in a prototype;

use the considerable resources of universal or large control computers compared to the microcomputer, especially, memory and peripheral devices for an automatic run of a large number of debugging versions, various documentation results, accumulating and storing program libraries and other work, which can be done on such computers, which are well provided with apparatus and program possibilities;

simulate the external situation by means of programs prepared by a universal or control machine and connected through the MPSK for operation of the specific microcomputer programs, this approach, naturally, may be used not only at the stage of creating concrete apparatus based on the microcomputer, but also in the process of studies and preliminary design work on the selection of the apparatus operation algorithm, the optimization of the proposed circuit-program coordination and the determination of adequately precise quantitative characteristics of the specific PO, which is especially important in developing apparatus with new technical characteristics or based on new operating principles (in many aspects possibilities of investigations by such facilities are considerably greater than the possibilities of reproducing the same results in the debugging test stand).

For systems using microcomputers with specific PO with a volume of 1 to 10K words, the pass at this stage and the one-step design lead to a considerable increase in the length of time for finishing-off the model on the microcomputer (two to three minutes) and possible loss of time in the two-step design.

This is due basically to two reasons. First, in the single-step design of the specific PO, during the period of finishing off the model on the microcomputer, the PO developers are forced to work for a long time with "raw" programs. Since, in the control systems of such a class, a considerable volume of PO is occupied by interaction with the apparatus, classification of causes for incorrect operation is made more difficult. Such are errors in algorithms or programs, errors in the assumed circuit-program understandings or apparatus faults. Besides the usual technical difficulties related to the search for causes of improper operation of the system, natural psychological problems of interaction between specialists on programming and electronics become more complicated. This is a very important factor at all design stages and determines the speed of creating a computer control system. The presence of monitoring versions of specific PO finished off by means of cross-facilities and imitation programs accelerates the finding of errors, simplifying the interaction between programmers and the development of the framework apparatus. Finished off text programs of apparatus created in accordance with algorithms, coordinated with its developers may also serve this purpose.

Secondly, a model finishing-off time, limited by concrete schedules with one-step design, must be partially spent on solving the above-indicated problems which, naturally, narrows the range of checking work, reducing the number of detected errors and increasing thereby the probability of correcting the PZU of the microcomputers in series manufactured apparatus.

However, with specific PO limited to 1K words, such solutions are possible by thorough implementation of the stage (two to three minutes) and experimental operation of the apparatus or device with a direct-access memory or a half-constant PZU (PPZU) (four minutes) with an adequate volume during a certain segment of time. Regrettably, it is impossible to give an accurate time evaluation of such a version because of the great variety of apparatus and conditions for implementing the stages (two to three minutes) and four minutes, the skill of the developers and other organizational and technical parameters that affect the quality and times of developments. At the same time, experience in creating a number of devices and apparatus on the basis of microcomputers indicates that under fairly favorable conditions device and apparatus developers, with a first approach to microcomputers, may complete the work to the fourth stage inclusive in 12 to 14 months, if the PO does not exceed 1K words. The work may be done using either the two-stage, or one-stage designing of the specific PO.

Examples of such work done on schedules close to those cited are the creation, on the basis of a single-plate microcomputer, of a device for primary processing of spectrophotometric data [8] with two-step designing, and the creation of a universal digital regulator [9] with one-step designing. These and a number of other developments, including the creation of a program subscriber point, indicated that the laboriousness of designing a 1K words PO for a broad purpose microcomputer, using the indicated facilities -- stages one to four (four minutes) -- is 10 to 17 man-months, with the first approach to the microcomputers. This figure is reduced to 1/12 - 1/2 in designing the following types of apparatus on the basis of microcomputers due to experience gained in using its program and facilities of the debugging system, as well as by using a clear-cut order in the design process.

Fig. 3 [not shown] shows the empirical relationships for the laboriousness of developing a specific 1K word PO as compared to total volume of PO. They were obtained on the basis of analyzing four stages of 11 developments on the basis of one-plate and multiple plate broad purpose microcomputers with PO from 1K to 21K words. These relationships (curves 1-1¹) coincides in many respects with known data abroad for control programs, operating in real time [10], recalculated into the coordinates of this figure (curves 2-2¹). The incomplete coincidence of areas, bounded by these pairs of curves, is due to a lack of record in the 2-2¹ curves on the time for comprehensive debugging and running the system, while the gentler slope of curves 1-1¹ is due to the use of cross-facilities for the development of program automation in developing the specific PO for the microcomputer.

The decisive stage in preparing the specific PO from the standpoint of the final success - quality operation of series apparatus on the basis of microcomputers -- is finishing off the program on the microcomputer along with the framework apparatus on a model or prototype of the apparatus. At this stage, the correctness of the selected ideology of designing specific programs and the selection of circuit-program agreements are subjected to final monitoring; the basic time characteristics of the microcomputer operation within the composition of the apparatus are also made more precise. In characterizing this stage, it is expedient to compare the program and apparatus possibilities of the facilities for its implementation:

a microcomputer equipped with residential facilities for the automation of program development (translator from the AVTOKOD, loader, program-apparatus monitoring of program operation);

a two-machine "microcomputer-EVM M220 (M6000)" complex with cross-facilities for automation of program development (translator from AVTOKOD, loader, MPSK).

The advantages of using only a microcomputer interfaced with a model of the object or its prototype are: there is no expense for creating a two-machine complex and equipping it with corresponding PO, as well as the speed of starting the work on the model, determined only by schedules of delivery of the microcomputer and its interface with the peripheral equipment. However, for enterprises whose technical policy is the creation of apparatus, devices and control systems on the basis of microcomputers, such a path is permissible only for the first development using microcomputers and only for the limitations indicated above. The maximal authenticity of debugging the specific microcomputer PO on a fairly limited schedule is achieved by using a two-machine complex that combines convenience of operation inherent in universal computers -- rapid input-output devices, an external storage unit -- with the functioning of an actual processor and input-output microcomputer devices jointly with the model of the object. Cross-facilities, placed on the "Senior" computer of the two-machine complex, serve for rapid and optimal modification of the programs of the specific PO in the process of their check and correction. These facilities may also be used for the cross-debugging program stage when designing the specific PO. But, as indicated by experience, at enterprises developing several types of products on the basis of microcomputers, the complex is almost continuously used from the beginning for individual stages of finishing off the apparatus:

interfacing the microcomputer complex with the model of the object or its prototype;

debugging the program modeling of the external arrangement in real time;

checking the operation of the specific PO;

functional testing of the model (prototype) for adopting a decision on the experimental operation of the product with PZU or with a direct-access memory (or PPZU).

Therefore, in cases where it is possible to use cross-devices for automating the development of the specific PO on the universal computer that is not contained in the two-machine complex, this is always expedient for reducing stages 1, 2 and 3 in developing products on the basis of the microcomputer.

In completing the characteristic of this stage, it is necessary to note its final phase -- functional tests. By this term, we mean a new process in the practice of designing apparatus, devices and control systems. Its appearance was originated by the fact that in designing products on the basis of the microcomputer, the basic share of the product functions, or the main ones, are implemented by program methods and the remainder -- by apparatus framework only, whose ratio reduces continuously with the increase in the speed of multiple-chip microcomputers and the introduction in practice of designing single-chip microcomputers. Therefore, test programs that implement the operating algorithm of the product, before they are reproduced in the PZU, become a necessary and individual part of the specific PO design process, while the nature of implementing the apparatus framework at this moment ceases to play a principal role (only its full functional correspondence to the future staff implementation). In this case, the tests of the specific PO and, practically, of the product or its model, must be made in accordance with those programs and methods used for testing prototypes (on the PZU, direct-access memory or PPZU with the specific PO). Such tests are called functional tests (unlike tests of prototypes, where the form of apparatus and software implementation are determined by existing norms).

On the basis of functional tests made on the model after it is finished off (three or two to three months), a decision is adopted on transmitting data about the specific PO for manufacturing a microcomputer with PZU for experimental operation and test stand tests of products on the basis of microcomputers or on preparing the product to carry it through these stages by storing the data in the direct-access memory or in the PPZU of the microcomputer. Usually, stage 3 is completed by transmitting the data for making the PZU, because facilities for implementing this stage insure high authenticity of the specific PO. At the same time, the results of the functional tests, made after the completion of the stage operation (two to three minutes), do not always indicate the possibility of making a BIS PZU, requiring experimental operation

on such data carrier as the direct-access memory or PPZU for more detailed checks of the product in various operating modes.

The thoroughness of preparation of the specific PO using the entire spectrum of facilities for its debugging becomes a still more important factor in using single-chip broad use microcomputers as computing devices built into the apparatus of the computer facilities. Correction of the specific PO in multiple chip microcomputers leads to the redesign of many replacement layers and the replacement of all or some BIS PZU which are only one of the functional components of the microcomputer. A similar correction, when using single-chip microcomputers, is the considerably more complicated "surgical" operation for remaking the chip, for all conditions of design fragmentation of its separate components, including the PZU.

Several conclusions can be made:

1. Using cross-facility automation of programming is not only a method for increasing the authenticity of the program, but is also a method for reducing the design time of products based on the microcomputer due to combining stages of finishing off the specific PO with other stages of product design.
2. Debugging products by means of a two machine microcomputer-universal computer (large control computer) "PO in series manufactured apparatus, starting from first prototypes."
3. The role of using the entire spectrum of facilities for debugging the specific PO increases with the use of single-chip computer devices and systems.

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ONE APPROACH TO THE SELECTION OF OPTIMAL GROUPING OF DIRECT-ACCESS
AND EXTERNAL MEMORIES OF COMPUTERS

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 6, 1979 p 87, 91

[Article by N. M. Sharunenko, A. Ye. Fateyev, S. M. Porotskiy]

[Excerpts] This article proposes an approach to the evaluation of the efficiency of computer systems (VS) that solve various classes of problems of a given configuration with the determination of the trends in changing the structure of component VS of individual technical facilities for the purpose of increasing the efficiency of their implementation.

This article, which is a further development of [2] proposes an approach to the determination of the data capacities of the direct-access memory and direct-access external memory depending upon the computer model selected and the classes of problem solved on it.

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DIGITAL COMPUTER FOR MULTICHANNEL PROCESSING OF EXPERIMENTAL DATA IN REAL TIME (TSVK "PIRS")

Kiev IPRATLYAVUCHIYE SISTEMY I MASHINY in Russian No 6, 1979
pp 130-136, inside back cover

[Article by G. I. Korniyenko]

[Text] Experiences in developing and operating systems of type [1], as well as experiments abroad, indicated that to solve problems of express-analysis of experimental data (ED) in the process of natural tests of complex facilities and their models, the most efficient are the modern universal systems using highly productive minicomputers that have the proper set of facilities (multichannel recording, storing, processing and documenting) and meet the requirements of the conditions of natural experimental investigations. On the other hand, successful implementation of such systems is possible only when equal attention is given to programming, computers, junction devices, measuring apparatus, as well as to the investigation of processes and phenomena of effects of various external and internal forces.

These were the initial positions of the developers of the system described in this article, the basis of which is a highly productive, compact, efficient two-process system with a wide number of peripheral devices controlled by a real time multiprogram OS [Operational system] and DDS [Disc operational system]. The system can solve the following basic problems simultaneously:

recording, gathering and storing large ED files over many channels;

multichannel input, preliminary processing and express-analysis of the ED of random rapidly-moving processes and phenomena by mathematical statistics and the theory of probabilities methods for identifying useful signals and identifying their physical nature;

review the ED as they are being received and ED document files and the results of their express-analysis on the developed network of TV and graphic devices, including videotapes;

divide the computer process between two (or more) processors and peripheral control devices, whose operation is combined in time with the processors' operation;

conduct a dialog between the experimenter and the system in the "question-answer" mode for controlling the experiment and changing the ED processing and analyzing modes;

automate programming in the dialog mode to develop and debug new user programs in the form of object modules;

implement general mathematical, scientific-technological and research calculations for planning the experiments according to programs introduced by users;

efficient and reliable protection of the system when power sources fail (accident) and full restoration of the system up to exchange with the peripheral devices after power is restored.

The basis of the system is a somewhat modernized basic model of a problem oriented microcomputer [3] for multipurpose applications in which the following possibilities are implemented: operation in the multiprogram mode, dynamic distribution and efficient use of the memory, parallel operation of all peripheral devices, reactions to a great number of external and internal interruptions, etc. The mini-computer includes the following (Fig. 1):

1) processor 1 with a built-in visual output display (UVZV) of alphanumeric and graphic data using an ELT [Electron beam tube] ;

2) control device (not shown in Fig. 1) with multiplex (MK) and high speed (SKK) channels to main line interfaces to which are connected start-stop, peripheral byte devices through interface charts (IK). These peripheral devices are: key input device (UVK), typewriter, photoread-out device, device for punched tape input, DZM-180 device for sequential mosaic printing, TT-63 telegraph teletype, as well as high-speed devices -- NMD YeS-5060, graphic output device (UGV) on electrochemical paper and a unit for communicating with the object through which are connected recorder ED, digital NML [magnetic tape storage] , 16-channel ATaP [Analog digital converter] analog NML and a combination (analog-digital) NML;

3) memory channel to common buses to which are connected memory units (BZU) of direct access and passive memories of various types;

4) channel for direct access to memory in four directions for the organization of multiprocessor systems;

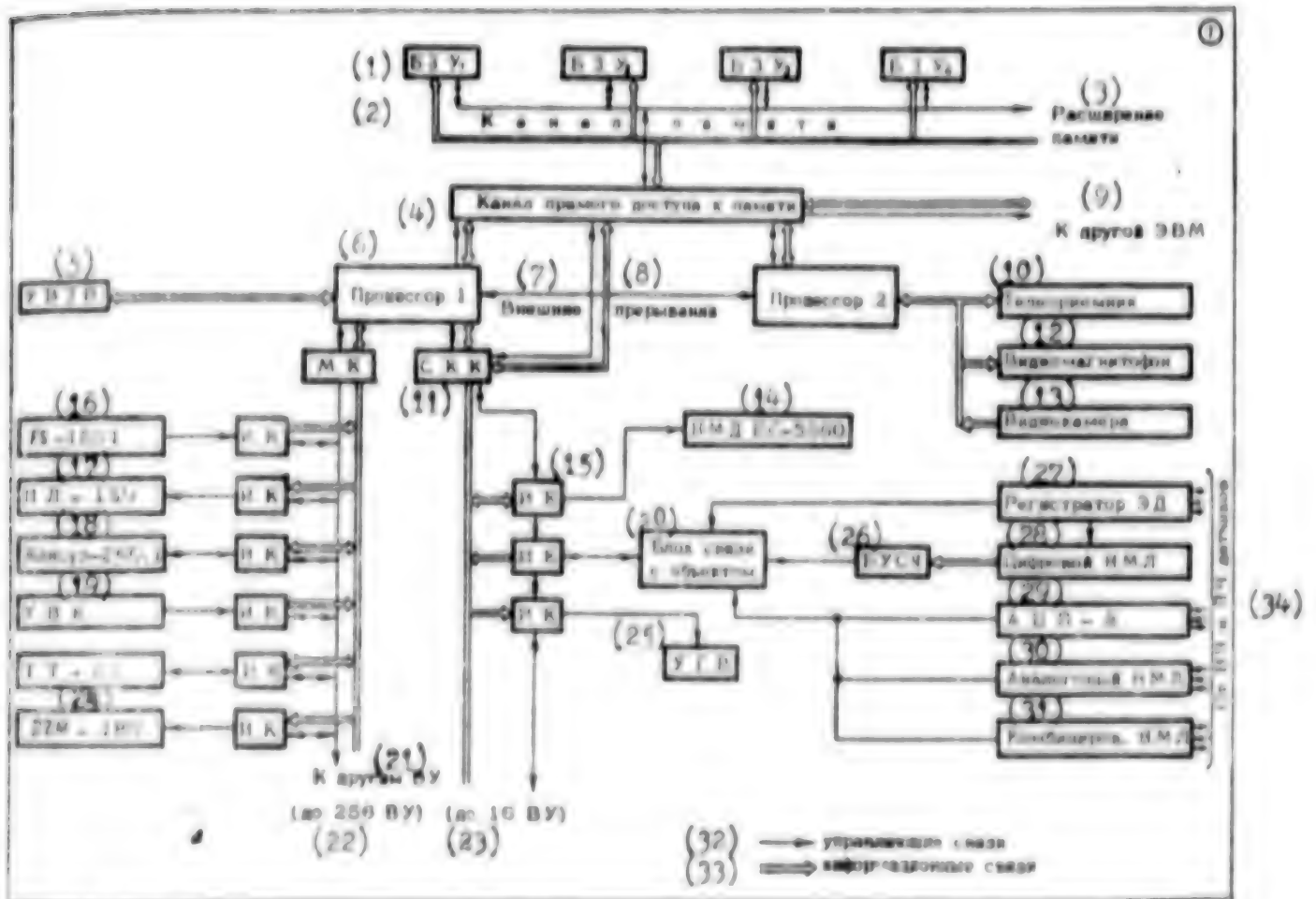


Fig. 1. Block diagram of the "Pirs" digital computer system.

- | | |
|------------------------------------|--|
| 1. BMU | 18. 260.1 Console |
| 2. Memory channel | 19. UVK |
| 3. Memory expansion | 20. DZM-180 |
| 4. Direct-access channel to memory | 21. To other VU |
| 5. UVZV | 22. (Up to 256VU) |
| 6. Processor 1 | 23. (Up to 16VU) |
| 7. External | 24. Unit for communicating with the object |
| 8. Interruptions | 25. UGV |
| 9. To other computer | 26. BUSCh |
| 10. Telereceiver | 27. ED recorder |
| 11. SRK | 28. Digital NMI |
| 12. Video magnetophone | 29. ATaP-8 |
| 13. Video camera | 30. Analog NMI |
| 14. NMI YeS-5060 | |

- 15. IK
- 16. FS-1501
- 17. PL-150

- 31. Combination NML
- 32. control communications
- 33. data communications
- 34. from high and low frequency sensors

5) processor 2 which is connected to one of the directions of the direct access channel and is the second computer system for combining complicated processes of multichannel ED input-output with their processing and analysis, as well as for controlling TV and video-TV devices. Processor 2 is fully compatible with processor 1 of the basic minicomputer and is controlled by its instructions. It has a unit for controlling video-TV devices with a symbol generator and a radio-TV channel to which are connected telereceivers type "Yunost'-402" (or any other series), a magnetophone with a video camera and monitor. In this case, the number of telereceivers is practically unlimited since they are connected to the channel by a radio cable to the receiver inputs, which permits the installation of receivers at a considerable distance from the system and obtains alpha-numeric and graphic data at locations of the tested object far removed from the location of the system.

The basic functional duties of processor 2 in the system are:

parallel operation with processor 1 of processing experimental data and analyzing their statistical-probability characteristics in accordance with the OS directives;

preparation of files for output to the telereceiver and to the UGV, as well as control teledevices when reviewing the ED and when the results of their express analysis are shown in the alpha-numeric and graphic forms;

control the video-recording of data on the video tape and its reproduction on the monitor and telereceiver;

synchronize and quantize the input data from the video camera into the TsVK [Digital computer system] .

OS synchronizes the operation of processor 1 and processor 2 by a system of external interruptions.

In simulated and natural tests of complicated objects, there almost always originates a need for rapid adaptation of the system, i.e., retuning the structure and algorithm of its functioning according to concrete problems and conditions. Having determined before the start of the tests the computing capacity of the system (the number and types of sensors, the frequency of the processed signals, the lengths of the answers, the type of recorders and ED memories, the calculated

characteristics, the technology of processing and ED analysis, availability of rooms for installing the apparatus, etc.), the user can obtain a corresponding configuration of the system. This is facilitated by the functional-unit principle of designing its technical facilities and software.

The basic set may be expanded by connecting an additional processor (including a specialized type BPF) or another computer to the fourth direction of the direct access channel, additional RZU, as well as by expanding the variety and type of peripheral devices. The system can be reduced to a single processor system, consisting of a basic minicomputer with a minimal configuration and a unit for communications with the object, by disconnecting the enumerated devices and units.

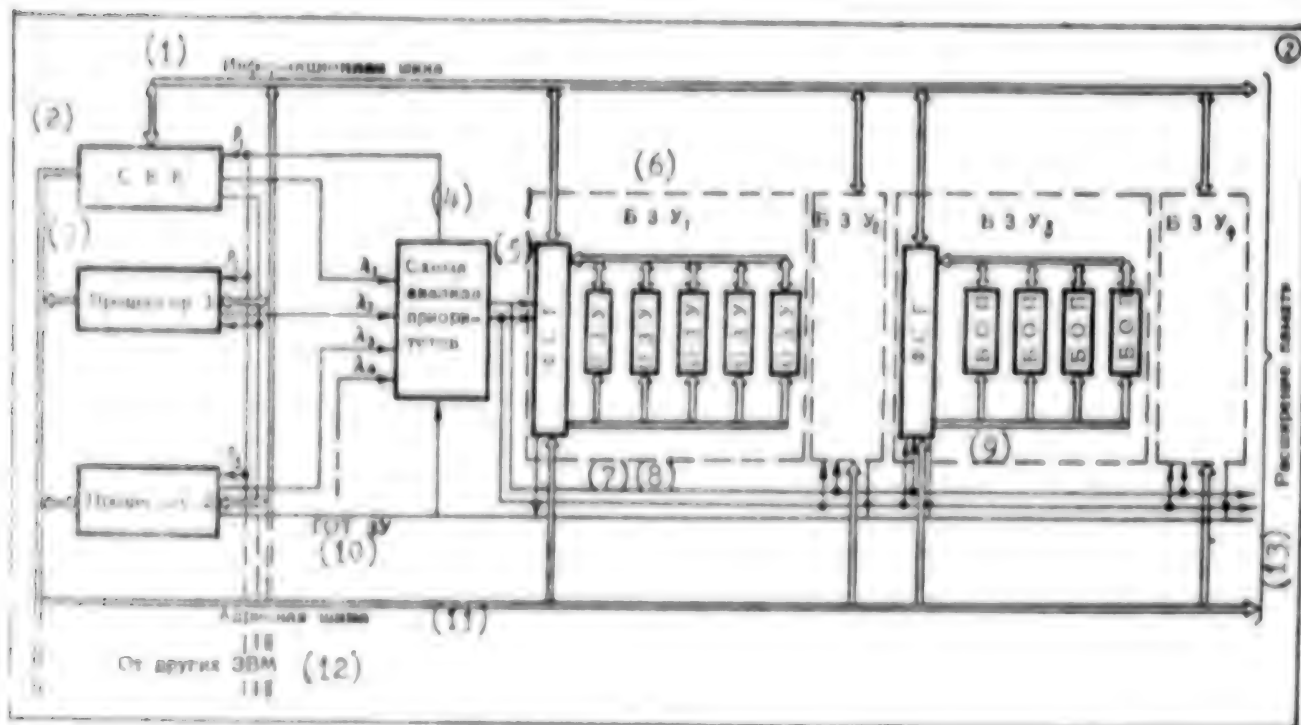


Fig. 7. Arrangement of access to memory of TsVK "Pirs".

- | | |
|----------------------------------|--------------------------|
| 1. Data bus | 7. PZU |
| 2. SKK | 8. OZU |
| 3. Processor 1 | 9. BOP |
| 4. Circuit for priority analysis | 10. GOT ZU |
| 5. FSC | 11. Address bus |
| 6. BZU | 12. From other computers |
| | 13. Memory expansion |

It is well known that the efficiency of a multiprocessor system depends considerably on how the access to the memory is organized. In the described system, the principle of a common memory for all subscribers is used that provides a single method for addressing the OZU and PZU [Permanent memory] cells. Fig. 2 shows the block diagram that clarifies the principle of multi-subscriber access that assumes the availability of common address and data buses and of a priority analysis circuit (SAP) consisting of a set of direct accesses to the memory.

Memory subscribers in the priority order are the SKK and processor 1 and processor 2 connected to the corresponding buses of the memory channel and to the priority analysis circuit. Interrogations to memories $\lambda_1 - \lambda_n$ (signals of read-out or data recording) are generated at the input of the latter which, after being analyzed in the SAP, are given out in the form of signals $P_1 - P_4$ on the busy condition of the common data and address buses to corresponding subscribers. The direct-access memory is sectionalized into 2048 16-bit binary words. All these sections, each of which has its own address register and number register, are combined in individual BZU. BZU₁ and BZU₂ have four OZU sections and one PZU section of 8096 words each, while BZU₃ and BZU₄ have four OZU units each.

Thus, the system has a 64K byte direct access memory and a 32K byte constant memory capable of expanding the latter to 128K bytes. This is a good characteristic for airborne systems for automatic ED processing. Each BZU has a circuit (FSG) for forming signals received over the common buses with an address decoder which is tuned to the cell address belonging to the given BZU. This makes it possible to exchange data with the memory sections of the TsVK without waiting for the full processing cycle in the other section. The exchange speed is determined only by occupancy time of the bus for recording the address and the number into the corresponding section and is 1.25 microsec on the average.

Signal GOT ZU clears the subscriber interrogation and disconnects the common memory buses which permits the switching to the priority analysis circuit to analyze the next in turn priorities. This organization of access to the memory makes it possible to:

continue the computing process when one of the OZU sections is out of order;

organize a synchronous recording to the total realizations (in various OZU sections) without time shifts between readings;

utilize the capacity of the memory more efficiently because extra "repumping" of data and programs into the individual ZU of subscribers is not required;

to easily change the problem orientation of the TsVK by changing the PZU cassettes;

increase the OZU transit capacity compared to the traditional access.

It is obvious that all these advantages can be realized most effectively only when the software (including that of the user) takes into account the described organization of access to the maximum. The TsVK software does the following basic functions:

loads the processors to the maximum;

serves the combined work of the TsVK on recording, gathering and storing ED in parallel with the work of the computing algorithms, including the reviewing of the results on the ELT screens;

serves operate peripheral devices by accessing them by logic names, which may be assigned by concrete physical devices in the process of system operation;

provide active dialog between the experimenter and the system by a language for conducting the experiment and DOS messages, whose directives at any moment may be introduced by a minicomputer UVK, without interrupting the computing process;

have a single data base -- files that provide efficient preliminary, dynamic and static ED processing and the evaluation of their statistically-probable characteristics (VSKh);

provide an independent and parallel solution of the problems in the 16 memory sections. Up to 16 related subproblems may be solved in the multiprogramming mode;

provide diagnostic monitoring of the processor operation, peripheral devices and individual mathematical components.

In its functional purpose, TsVK software is divided into a general and special system.

The basis of general system software (Fig. 3) is real time multiprogram DOS ETA, structure, composition and functional purpose of various components described in adequate detail in [3], while the control component is described partially in [4] and the processing -- in [5].

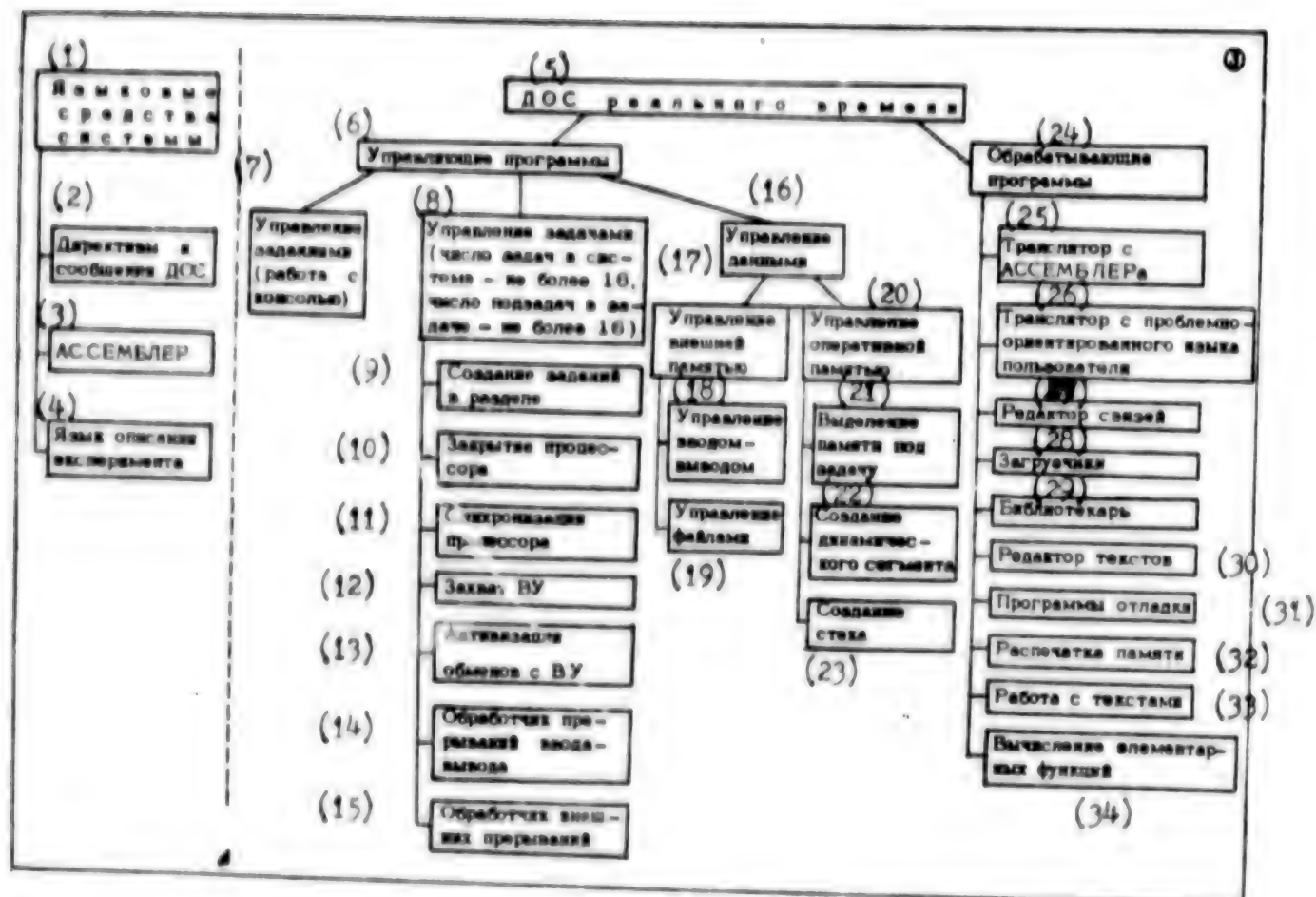


Fig. 3. Block diagram of general system software for the TsVK "Pirs".

- | | |
|---|--|
| 1. System languages | 18. Control input-output |
| 2. DOS directives and messages | 19. Control files |
| 3. ASSEMBLER | 20. Control direct access memory |
| 4. Experiment description language | 21. Assign memory for problem |
| 5. Real time DOS | 22. Create dynamic segment |
| 6. Control programs | 23. Create drain |
| 7. Problem control (number of problems in system -- not more than 16, | 24. Processing programs |
| 8. number of subproblems in problem -- not more than 16 | 25. ASSEMBLER translator |
| | 26. Translator of problem oriented user language |
| | 27. Communications editor |
| | 28. Loaders |

- | | |
|---|---|
| 9. Creation of tasks in the section | 29. Librarian |
| 10. Processor closed | 30. Text editor |
| 11. Processor synchronized | 31. Debugging programs |
| 12. Clamp VU | 32. Open memory |
| 13. Activation of exchange with VU | 33. Work on texts |
| 14. Processor of input-output interruptions | 34. Calculation of elementary functions |
| 15. Processor of external interruptions | |
| 16. Control data | |
| 17. Control external memory | |

Special software (Fig. 4) is a set of program facilities intended for authentic measurements and processing of ED to obtain their VSKh and various evaluations, and includes programs for preliminary, static and dynamic ED processing, as well as programs for calculating and transforming functions into various number representation systems (list of library program system modules which, when desired by the user, may be changed, expanded and reduced at the end of the item).

In case the TsVK is installed aboard an aircraft, the ED input is implemented directly by sensors on board the plane through the apparatus on board for recording ED, or through digital NML, or through the combination NML, or an analog NML (through the ATsP-8). In this case, the input and processing ED from the indicated memories in the process of testing provide reliable monitoring of their recording.

When the TsVK is installed very close to the tested object, the input and processing of ED is made from magnetic tapes either digital or digital-analog NML, or from an analog NML (through the ATsP-8). In this case, the processing technology is more complicated because it is necessary to duplicate the apparatus for magnetic recording and reproduction, installed aboard the aircraft and in the system.

The main(leading) program is prepared in the language of the description of the experiment taking into account the problems and technology of conducting the experiment. This language is a system of rules for filling the record of the problem. These rules indicate the following: tests, methods for arranging and paralleling local switches and channels, the quantity and numbers of process sensors, the lengths of the results, the necessary VSKh and programs for preliminary, static and dynamic data processing, names of external and peripheral input-output devices, names of calibrating table files and ED files, the appearance and form of reports, etc. Before the start of the tests, all this data is introduced by the UVK, into the system memory in the

dialog mode by means of directives and messages of the DOS or OS. The computer initiates the dialog. The record of a problem that does not need editing may also be introduced from the perforated tape. Later, the translator automatically translates the initial program into the module for execution.

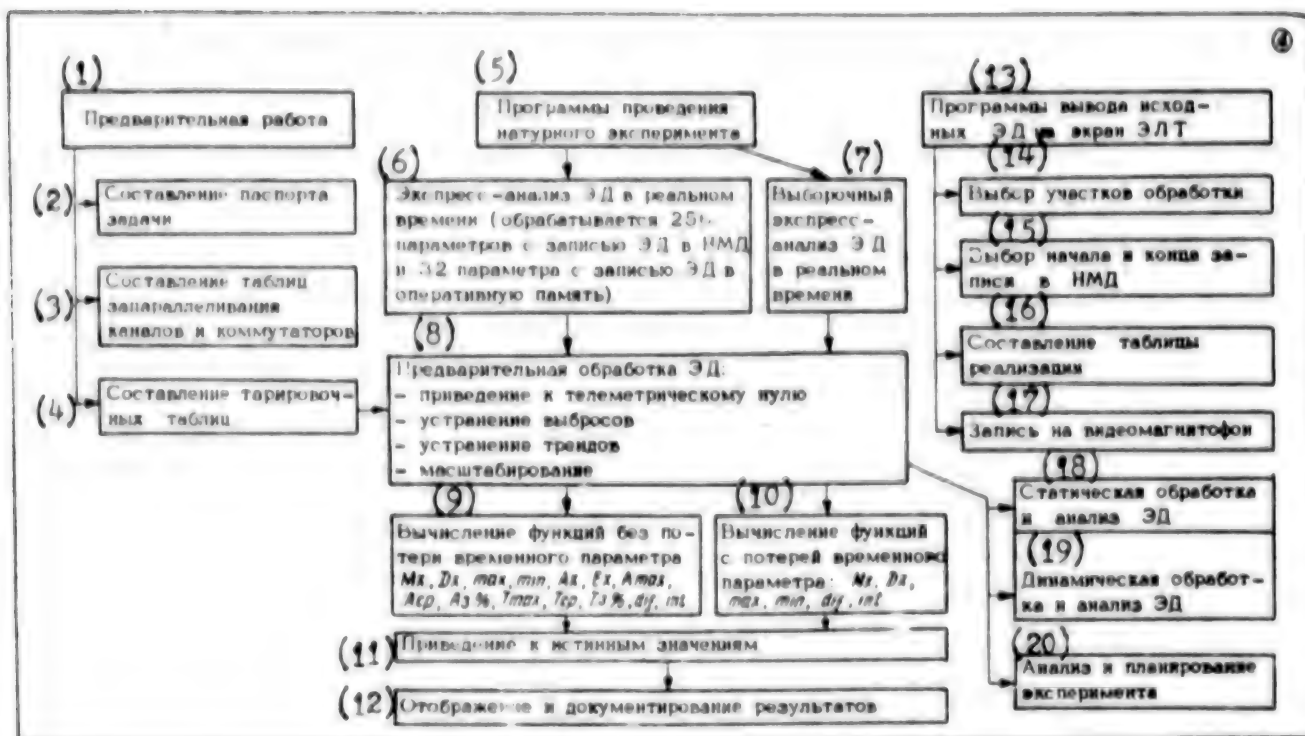


Fig. 4. Block diagram of special software for the TsVK "Pirs".

- | | |
|--|--|
| 1. Preliminary work | 11. Reduction to true values |
| 2. Preparation of problem record | 12. Display and result documentation |
| 3. Preparation of tables for paralleling channels and switches | 13. Programs for initial ED output on ELT screen |
| 4. Preparation of calibration cables | 14. Selection of processing sections |
| 5. Programs for carrying out a natural experiment | 15. Selection of start and end of recording in the NMD |
| | 16. Preparation of realization tables |

6. Express-analysis of ED in real time (256 parameters are processed with recording of ED in NMD and 32 parameters with recording ED in direct access memory)
7. Selective express analysis of ED in real time
8. Preliminary processing of ED:
 - reduction to telemetric zero
 - elimination of rejections
 - elimination of trends
 - scaling
9. Calculation of functions without losing the time parameter: Mx, Dx, max, min, Ax, Ex, Amax, Acp, A3%, Tmax, Tcp, Ts, dif, int
10. Calculation of functions with loss of time parameter: Mx, Dx, max, min, dif, int
17. Recording in video magnetophone
18. Static processing and analysis of ED
19. Dynamic processing and analysis of ED
20. Analysis and planning the experiment

ED processing is done in real time, i.e., simultaneously with ED recording and storing, and in the mode of selective express analyses, i.e., between two successive tests. While, in the first case, the system monitors the limiting characteristics of the units of the object, the working order of the recording and storing apparatus, etc., in the second case, it makes a comprehensive evaluation of the operating modes of the object, on the basis of which a strategy is selected for the following experiment. A finer and more accurate analysis of ED and the obtained results is made between the end of one series of tests and the start of the next series.

At all stages of ED processing, it is entirely natural for the experimenter to see results or parts of results of interest to him to evaluate their usefulness for further processing. In practice, these results are usually recorded on oscillograms, various (light-sensitive, electrochemical) paper tapes, etc., the automatic processing of which is, obviously, impossible. For this reason, the considered system can show results on telereceivers. When the operator so desires "raw" results or results obtained by preliminary processing are displayed on the screen in the form of signals with time marks, which are recorded on a magnetic tape or are formed by a basic mini-computer with timers. These results "flow" on the screen fairly smoothly and sections of interest to the experimenter may be brought

out through the UGV on a paper tape or recorded on a videomagnetic tape recorder. Time indicators of the beginning and end of such sections fixed and recorded in the problem record are selected and processed automatically in accordance with corresponding programs when a repeated read-out of the tape is made. Experience shows that the physical possibilities of the experimenter make it impossible for him to look over more than three-four results simultaneously.

High frequency data (with input frequencies of up to 10kHz per channel) are stored in the NMD and checking their results (as express-analysis and further processing) is done from a magnetic disc. For this purpose, the greatest part of the NMD memory is reserved for recording high frequency results and only a small part -- for DOS programs.

In trying to give the experimenter a greater capability of observing the occurring phenomena not only in accordance with processing results, but also visually, developers provided modes of recording the data of the telereceiver on a video tape and an input of video camera pictures in the machine memory. This makes it possible to study more closely the physics of the phenomena, compare the results of processing and videorecording, for example, of interfering external forces in various phases, dynamics of motion, etc.

The system includes a number of interesting working and servicing modes, whose detailed description is beyond the framework of this article. We will only note that since they are located in the PZU of the program level, they are always ready for work and when there is an accidental power failure, the system is automatically locked out with the possibility of its restoration after power is restored, etc. In spite of such broad functional possibilities of the software, practically all of it is located in the 32K bytes of the PZU, with all the enumerated OS functions accessible to the user even with a minimal configuration of the TsVK. Such compact OS and DOS in real time have no equal.

The TsVK "Pirs" (its external view and basic technical characteristics are shown on the inside of the back cover) has a modular structure of technical facilities that meet norm requirements for size, weight, rigidity and air conditioning of individual units and the system as a whole. Printed circuits are used which are located in standardized portable units, are assembled in frames and are interconnected by cable. The frames and the NMD are mounted on adjustable bases containing shock absorbers and holes for rigid attachment to the floor. To attach the TsVK frames when operating on mobile transport facilities, rigging screws are provided with ends up to five meters long. Individual

air conditioning of frames and units is provided. The operating capacity is maintained with ambient temperatures from +5 to +40°C, 95% humidity at (+30°C), pressures of 630 to 800mm of the mercury column and at 2q vibration with frequency up to 30Hz.

The high computing capacity, the modular design of the technical facilities and software, the small size and high mobility and the ease of reorienting the system toward new problems make it possible to conclude that the proposed TsVK is an efficient computer for multipurpose applications. It may be used in all areas of science and engineering where it is necessary to measure, identify and analyze random processes under natural (field), as well as laboratory conditions of tests of complex objects.

List of library program modules of the "Pirs" system.

Functions and Conversions

Calculations of functions $\sin x$, $\cos x$, $\operatorname{tg} x$, $\exp x$, $\ln x$, $\operatorname{arctg} x$, $\operatorname{arcsinx}$, snx , thx , $\operatorname{SQRT}x$, $\operatorname{SIGN}x$.

Conversion of a number with a floating decimal point into text (three and six mantissa digits).

Conversion of binary number into text in 16-bit form.

Conversion of text into integer (short and long formats).

Conversion of integer into text (short and long formats).

Conversion of text into number with floating decimal point and into 16-bit number.

Unpack data from type F-203 ATsP.

Mathematical Calculations

Raise a complex number to an integer power.

Convert a complex number from an algebraic to a trigonometric form (and conversely).

Multiplication, division, addition and subtraction in the algebraic form.

Multiplication and division of complex numbers in the trigonometric form.

Matrix inversion.

Multiplication, subtraction, addition and matrix transposal.

Solution of linear algebraic equations systems.

Multiplication of a matrix by a vector.

Scalar product of vectors.

Calculation of a determinant.

Find all real roots of algebraic and transcendental equations by Rybakov's method.

Solution of N-th power algebraic equations by Rybakov's method.

Make more precise solutions of algebraic (transcendental) equations by simple iteration methods of Ihord and Eytkin-Steffenson.

Calculation of N-th power polynomial values at some point and values of the first derivative of this polynomial.

Provide read-out of histograms in the ADP and file in the N columns.

Provide an input of an integer, a real number and a file of real numbers in the dialog mode.

Statistical Processing of Experimental Data*

Calculation of mathematical expectancy of the time series.

Calculation of dispersion.

Calculation of torques.

Centering the time series.

Determination of the maximal and minimal values of the series.

Conversion of a real into a complex series.

Calculation of the probability argument.

* All programs for statistical ED processing have corresponding dialog texts in the library that make it easy to debug these problems.

Calculation of the argument according to a given value of the normal distribution function.

Calculation of the Pearson square criterion.

Calculation of auto- and mutual-correlation functions.

Generation of pseudo-random numbers.

Direct and inverse rapid Fourier transformation (RPF).

Calculation of the energy spectrum and the mutual energy spectrum by the RPF.

Calculation of the absolute value of the mutual spectrum.

Calculation of the energy spectrum by the Fourier transformation cosine.

Calculation of the time window according to Bartlett, Hamming, Hanning and Pugachev.

Cosine Fourier transformation.

RPF of a real series and two real series.

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"Pira" computer system

Basic technical characteristics

Number of channels

4

Number of recorded sensors

a) by airborne ED recorder (taking into account third degree system for measuring temperatures) or by digital NML

up to 1000

b) analog NML or ATsP-8

16

c) combination NML

96

Frequency of ED reception (KHz);

a) from airborne ED recorder or from digital NML

12.6

b) from ATsP-8

100

c) from combination NML

20

Frequency of "thinning out" ED with coefficient 2^{-k}	(k = 1 to 5)
Number of simultaneously processed sensors	256 max.
Direct access memory:	
a) capacity in basic set	64K bytes
b) possibility of expansion	to 128K bytes
c) average access cycle	1.25 microsec
PZU for locating programs:	
a) number of units	2
b) total capacity	32K bytes
c) access cycle	1 microsec
PZU for locating microprograms:	
a) number of units	2
b) total capacity	20K bytes
c) possibility of expansion	to 80K bytes
d) access cycle	1 microsec
Magnetic disc storage:	
a) number in set	1
b) disc capacity	850K bytes
c) number of heads	256
d) exchange speed	180K bytes
Magnetic tape storages:	
a) number in set	3
b) length of tape on reel	up to 750m
c) capacity of one reel	15-20 M bytes
d) number of tracks	16-20
e) method of recording	code and pulse frequency modulation
Graph plotter:	
a) number in set	1
b) type of tape (paper)	EKhBI
c) speed of tape pull	0.25 to 1.2m/sec
d) tape width	218mm
e) number of electrodes	312
Video magnetic recorder with video camera:	
a) time for recording data	about 30 min.
b) reproduction speed	0-19m/min

Displays using ELT:

- a) number in set
- b) possibility of expanding number of devices over the TV channel
- c) size and type of tube
- d) form of processed data
- e) regeneration speed

2

unlimited
32LK and any
standard
receivers
alpha-numeric
and graphic
50Hz

Area occupied by the TaVK

about 14m²

Power from AC network (220v, 50Hz)

up to 3KVA

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I MASHINY" 1979
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C80: 1863

ABSTRACTS OF ARTICLES FROM THE JOURNAL OF CONTROL SYSTEMS AND MACHINES

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 6, 1979 pp 147, 149

[Excerpts]

UDC 681.3.14/21

COLLECTIVE USE DIALOG SYSTEM FOR DEBUGGING PROGRAMS WRITTEN IN MNEMOKOD

[Abstract of article by Bukin, V.V., Zhukovskiy, V.G., Yatlenco, M.T. pp 57-59]

[Text] A software system is proposed that permits six users to debug programs in the time division mode written for class ASVT-M M6000 minicomputers on an Assembler. The SID-1000 display is the working position of each user. Editing the data symbols is implemented by the apparatus facilities of the displays. Illustrations 1, Bibliography has one title.

UDC 681.3.06:622.269/9

ALGORITHMIC DESCRIPTION OF AN APPLIED PROGRAM PACKET FOR LINEAR AND NON-LINEAR IDENTIFICATION

[Abstract of article by Meleshko, V.I., Pesina, R.I., Markova, L.I. pp 59-66]

[Text] A problem-oriented program packet for solving identification problems is described. Structures, various ways of posing problems and basic modules are described, and principal features are indicated for creating a monitoring program which, from these modules, compiles efficient algorithms intended for solving the indicated problems and the statistical processing of data files. Illustrations 1, Bibliography has 25 titles.

UDC 681.3.51/6.42

RESULTS OF MACHINE EXPERIMENT ON SOLVING THE PROBLEM OF INTEGRAL LINEAR PROGRAMMING WITH BOOLEAN VARIABLES

[Abstract of article by Sergiyenko, I.V., Volkovich, V.L., Rooshchin V.A., Voloshin, A.F., Sakhno, G.A., Siyanitea, N.N., Yaremchuy, T.G. pp 66-69]

[Text] Results are given of a comparison study of Balash's algorithm, method W algorithm and method of the vector slope for solving problems of integral linear programming with Boolean variables. Tables 2, Bibliography contains nine titles.

UDC 681.3.0.06.614

CONJUGATION OF PROGRAMS WRITTEN IN PL-1 AND FORTRAN-IV LANGUAGES

[Abstract of article by Gal'chenko, O.N. pp 69-71]

[Text] Conjugation algorithm for PL and FORTRAN programs within the DOS-Yes [Disc operational system Single system] is considered. According to this algorithm, the active PL procedure for the dynamic memory is preserved by transferring it into a free memory of the section. Illustrations 1, Bibliography contains one title.

UDC 681.3.06./94

DISPLAY-ORIENTED SOFTWARE SYSTEMS FOR THE M6000 COMPUTER

[Abstract of article by Ioffe, M.P., Ivanov, O.N. pp 72-77]

[Text] A number of display-oriented software systems for the M6000 computer is described for operational translation, editing and implementing user programs written in MNEMOKOD and FORTRAN. Illustrations 1, Tables 1, Bibliography contains four titles.

UDC 550.827:622.241:62-529

ALGORITHM FOR REPRESENTING MAP COMPONENTS ON THE GRAPHIC DISPLAY SCREEN

[Abstract of article by Gumenyuk, A.I. pp 77-82]

[Text] Problems are considered of designing software for representing cartographic objects on a graphic screen. Principles for designing input and graphic recordings for describing linear and area symbols and signatures are formulated and substantiated. It is proposed to use the concept of the cyclical section of a linear symbol and its formulas to describe linear symbols. Basic problems were considered which involve the development of software for representing cartographic objects of various types. Illustrations 5, tables 2, bibliography contains seven titles.

UDC 681.3.06./14

EXTERNAL EFFICIENCY OF APPARATUS MONITORING OF COMPUTERS AND THE FUNDAMENTAL POSSIBILITIES OF ITS ACHIEVEMENT ON THE BASIS OF THE NATURAL RANDOMNESS OF POSITIONAL NOTATION

[Abstract of article by Bryukhovich, Ye.I. pp 83-87]

[Text] The possibility was shown of the external efficiency of circuits for monitoring and detecting computer errors on the basis of the natural

randomness of positional notations. The fundamental impossibility was established of creating such circuits when monitoring in accordance with the absolute value. Bibliography contains nine titles.

UDC 681.325.65

GRAPHIC DIALOG SYSTEM FOR INPUT AND EDITING STRUCTURAL AND BLOCK DIAGRAMS

[Abstract of article by Taurin, O.F., Makhinenko, L.I. pp 112-116]

[Text] A dialog system is described which forms graphic images of structural and block diagrams on the display screen. It was created on the basis of the domestic series manufactured M6000 computer and SIGD display. The software of this system was designed on the basis of a packet of applied programs of dialog systems. The organization of interaction between "user-computer" was shown, as well as the structure of the system and the basic instructions that determine the possibilities of the system. Special features of realizing the program are described. Illustrations 3, bibliography contains eight titles.

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CSO: 1863

MAN AND COMPUTER DIALOG: SYSTEMS FOR THE DESIGN OF PROBLEM SOLVING ALGORITHMS

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 79
pp 18-23 manuscript received 16 Jan 79

BRANOVITSKIY, V.I., DOVGVALLO, A.M., ZHUKOV, V.V. and KUDRYAVTSEVA, S.P.

[Abstract] Research conducted during recent years at the Institute of Cybernetics of the Ukrainian Academy of Sciences in conjunction with the Computer Center of the Belorussian State University and the Scientific Research Institute for Psychology of the Ukrainian Academy of Sciences to develop algorithms for problem solving via man/machine interaction, to precisely specify the problem conditions and to feed the algorithm into a computer is reviewed. These dialog systems are oriented towards different categories of users: DISKAOD [dialog system of algorithm design for the solution of data processing problems] and AKAOD [automated algorithm designer for the solution of data processing problems] for inexperienced users; and SVARZ [system of problem solving algorithm entry from a remote terminal] for experienced users. All of these dialog systems were realized on the Minak-32 computer within the framework of the YaOD-75 system [YaOD= data description language]. The requirements placed on dialog systems for program design are formulated and typical structures of the systems are shown in a block diagram and sample program printouts. Figures 6; references: 13 Russian.
[183-8225]

A MAN-MACHINE SOLUTION SEARCH PROCEDURE IN MULTIPLE CRITERIA OPTIMIZATION PROBLEMS

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 79 pp 24-29 manuscript received 23 Sep 78, after revision 23 May 79

VOLKOVICH, V.L. and VOYNALOVICH, V.M.

[Abstract] The choice of a production plan for an enterprise based on mathematical economic indicators requires the weighted evaluation of a variety of optimality criteria. The most promising approach draws on additional heuristic information from either the decision maker or a group of experts. The preference of either of these decision makers is incorporated as the criteria in a general mathematical model for a man-machine solution search procedure in optimization problems involving several criteria. The proposed procedure is independent of the type of problem to be solved and can be easily included in an existing system for optimal enterprise planning. The mathematical formulation is predicated on set theory and has the following characteristics: 1. In all steps of the dialog process, the decision makers operate in a criteria space which is of a much lower dimensionality than the alternatives space; 2. In analyzing the auxiliary information for the choice of the desired values of the criteria functions, the decision makers concentrate their attention directly on the values of the criteria functions at reference and effectuation points, which limit the cone of possible preferences; 3. The decision makers do not operate with the entire range of permissible values of criteria functions, but rather with a portion of it, determined by the desired values of the criteria functions, something which does not distract them in considering various unnecessary details. The proposed dialog procedure has been written in PL-1 language for the operating system of the unified system of computers and is being used to solve problems of production planning at enterprises by means of linear programming models. References: 11 Russian. [183-8225]

AN APPROXIMATE CALCULATION OF PRODUCTIVITY LOSSES AND THE DETERMINATION OF THE LOADING OF MULTIPROCESSOR COMPLEXES IN THE CASE OF CONFLICTS IN A PARTITIONED COMMON MEMORY

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 79 pp 29-34 manuscript received 19 Dec 78, after revision 14 Apr 79

SHTRIK, A.A.

[Abstract] The problem of productivity losses due to memory interference in multiprocessor computers is analyzed for the case where the number of processors and mainframe memories are specified parameters. For the approximate formulas derived, the error between the calculated data and the results of statistical modeling of these losses is also estimated. The second issue treated in the paper is related to the derivation of formulas for calculating the actual loading of multiprocessor computer systems, which handle a random flow of claims for the execution of functional problems, where this load is determining with consideration of forced shutdowns of the processors with interference in the main memory. The relative disparity between the calculated and statistically modeled results for the productivity is shown graphically as a function of the number of memories, as is the productivity itself. The maximum error runs up to 5% in the case of a system with 6 processors. A sample calculation shows that in a system with four processors having four main memories, the increase in loading due to conflicts in the memory amounts to 10%; for eight processors under similar conditions, the actual loading corresponds to an increase of 60%. The maximum amount of the overstatement of the losses computed from the formulas in the case of eight processors does not exceed 10%. The figures adduced indicate that the application of the approximate methods provide acceptable precision in the final results. Figures 3; references 15: 11 Russian; 4 Western.
[183-8225]

A PACKAGE OF PROGRAMS FOR CHECKING DATA RELIABILITY IN AUTOMATED CONTROL SYSTEMS

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 79
pp 46-51 manuscript received 21 Mar 79

TIMOFEYEV, B.B., LITVINOV, V.A., ZHOLUD', L.V. and KRAMARENKO, V.V.

[Abstract] A data entry program generator is combined with a package of check routines for the unified system of electronic computers to facilitate the programming of a variety of information test procedures. Emphasis is placed on the application of the routines to the detection of errors in input data, though individual program modules can be used for checking files, for example where these are the result of solving automated control system problems. The total package contains a series of macroinstructions and modules used in the working data entry programs and routines for evaluating characteristics and generating files for compatibility and nomenclature checks. A discussion of error classification into syntactic, semantic, orthographic, meaning and entry group errors is followed by a brief treatment of data check methods and the role of various redundancies utilized in them. The efficiency of check procedures is estimated for the case of orthographic and meaning errors, and it is shown that certain types of data check procedures close to the theoretical limit. Figures 2; references 6: 4 Russian; 2 Western.
[183-8225]

ON THE AUTOMATED PREPARATION OF PROGRAM AGGREGATES FROM MODULES USING DIFFERENT LANGUAGES

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 79 pp 54-60 manuscript received 24 Jan 78, after revision 17 May 79

LAVRISHCHEVA, YE.M.

[Abstract] The APROP system is designed for the automated production of program sets from modules written in languages of different levels. The specification data defining a module are logic and program completeness, independence, i.e. the property of repeat useability, self-consistent in terms of control, data transmission and memory utilization, etc. The modular design procedure for the program sets is predicated on top-down functional

logic planning of a problem, while the program development uses both top-down and bottom-up programming. The elemental components of the program aggregate structure: module, macromodule and data module are defined and the capabilities of the APROP system are discussed as applied to the unified system of electronic computers. The first stage of the APROP system, which was turned over to the interdepartmental commission in late 1978 provides for the following: 1. Automated preparation of program sets from units described in the PL-1, FORTRAN and ASSEMBLER languages; 2. Dialog management of private and system libraries; 3. Automated accessing of algorithm and program banks. The software volume runs to more than 150 K. The following are required for the operation of the system: 512 K of main memory; 4 magnetic disk stores; a YeS-7096 terminal and 1 magnetic tape store. The system is being introduced in a number of the nation's organizations and extended to include the COBOL and ALGOL-60 languages. Figures 2; references 13: 12 Russian; 1 Western.
[183-8225]

UDC 62-52:681.3.06.2

ON ONE ROACH TO THE DEVELOPMENT OF AUTOMATED CONTROL SYSTEM SOFTWARE

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 79
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KAVALERCHIK, B.YA.

[Abstract] The increasing number of automated control systems [ASU] has made it necessary to develop programming procedures which provide for high program and programmer efficiency. The poor efficiency of the working routines for the solution of ASU problems derived by translation from high level languages is related in the majority of cases to the particular set of operators which comprise a minor portion of the program text, the running of which corresponds to the frequently used technological operations and occupies the bulk of the overall program computing time. Writing low level language modules to perform the operations, and incorporation them in high level language programs makes it possible to obtain working programs of better quality without increasing the volume of work or programming and debugging time. An example of this approach used in the ASU for the Belorussian SSR State Committee for Agricultural Equipment is described, where the processing involves data files on magnetic tapes have a volume of up to 10 - 15 million symbols. Two years of operational experience with YeS EVM [unified system of electronic computers] COBOL has demonstrated that the use of a translator and designer recommendations makes it possible to increase speed by a factor of two to four over the previous routines which were a direct translation from the COBOL of the "Minsk-32." A library of programs was developed to overcome deficiencies inherent in the use of high

level languages for the working ASU programs, and the method described was used for the development of more than 100 ASU programs, subsequently proving its effectiveness. References: 7 Russian.
[183-8225]

UDC 681.3.06./97.2

ON THE CODING OF CONTROL DATA IN ONE CLASS OF REDUNDANT CODES

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 79 pp 93-98 manuscript received 10 Aug 78

BRYUKHOVICH, YE.I.

[Abstract] The representation of control data in a computer by a highly redundant positional code is studied. The essence of the code consists in providing for p positions for numerals in a base p system, where the numbers from 0, 1, 2, ... $p - 1$, and providing one (unitary) symbol which is weighted in accordance with the number of the position in which the symbol is placed. This approach has the following advantages: the capability of physical representation of the coded data using a binary components base regardless of the base of the numeration used; faster arithmetic operations speed, which is greater the higher p is. The basic feature of the representation of control data in a positional code is the fact that because of the code structure, each of the digits of a control word takes the form of a spatially distributed system of signals corresponding to the spatial nature of the arrangement of the elements being controlled. It thus becomes unnecessary to build decoders and the operational speed of the computer control devices becomes the maximum possible, other conditions being equal. Coding instructions and micro-instructions in the same class of positional codes in which the numerical data is represented in the computer permits the representation of all machine data in one class of such codes, something which assures the capability of monitoring all computer assemblies and channels independently of their functional affiliation, using the same monitor criteria. A third consequence of positional coding is the possibility of reducing the occurrence of the three possible types of errors in such codes. It is apparent though that the representation of data in a positional code is accompanied by large hardware outlays, because of which it can be used only in those cases where the increase in equipment expenditures for data representation is considered less important than providing for the check capability and high speed in a computer. Figures 3; references: 11 Russian.
[183-8225]

THE ASP-53 AUTOMATED DESIGN SYSTEM FOR MULTILAYER PRINTED CIRCUIT BOARDS
USING A TOPOLOGICAL PROCEDURE

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 79 pp
113-117 manuscript received 27 Jun 78, after revision 24 Apr 79

SHIRO, G.E.

[Abstract] The ASP-53 automated printed circuit design system consists of units performing the following functions: 1. The development of the base structural design and the design of the original topological model; 2. The description of the electrical circuit; 3. Entry into the computer archive, printout of the listing, checking, modeling; 4. Placement of the components and layout of the wiring; 5. Topological tracing, design of the topological model; 6. Geometric tracing, design of the geometric model (the precise blueprint); 7. Fabrication of the photographic templates and issuance of the designer documentation. The design of the base structure and the original topological model consists of the following procedures: 1. The determination of conflicting positions; 2. The elimination of insubstantial conflicting positions; 3. The memory storage of intersecting critical segments; 4. Tying leads together at points; 5. Triangulation of boundaries. The topological routing consists of: 6. Ascertaining cells have no continuity, where the incontinuity can be eliminated; 7. Transfer of a conductor. The geometric routing consists of: 8. The layout of bottlenecks; 9. Route plotting. The EM-538 and M-2005 photographic coordinatographs are used for the fabrication of the templates of the multilayer printed circuit boards. The results of designing two boards are presented in tabular form where the boards had four and nine signal layers respectively and the design time on the YeS-1033 computer was 5 and 60 minutes. In each case, the number of external leads was 78 and 342 respectively. The ASP-53, in conjunction with the YeS-1033 computer having a main memory of 256 K bytes, has the following capabilities: the number of circuit leads can be no more than 12,000; the number of layers is practically unlimited and the time for tracing a circuit containing K leads is about $0.06 K^{1.5}$ seconds. Figures 5; references: 5 Russian.
[183-8225]

A MICROPROCESSOR SYSTEM FOR THE AUTOMATION OF EXPERIMENTS TO STUDY THE STRENGTH OF MATERIALS - "PROCHNOST"

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 79
pp 129-131 manuscript received 3 Jan 79

GRISHKO, V.G. and MARALIN, V.G.

[Abstract] The "Prochnost" system for computerized control of 1231-U10 strength testing machines was designed at the Special Production Engineering Design Office of the Institute of Strength Problems of the Ukrainian Academy of Sciences. The controller is designed around the K580 IK 80 microprocessor. The system performs the following functions: 1. Generation of the numerical and symbolic data files for the original data, including the characteristics of the samples being tested; 2. Establishing the parameters of the operating modes of the system (the number of connected transducers, measurement ranges, number of meters, measurement periodicity, etc.); 3. Generation of the numerical data file obtained by the programmed automated measurement of the transducer signals; 4. Generation of the numerical and symbolic data files fed in by the operator after the test; 5. The recording of the data files on a vehicle suitable for feeding the information into a large computer; 6. Signaling the operator concerning the operating modes of the system, faults, etc.; 7. Display of the current values of the parameters being measured. The operation of the interface is described and block diagrams of the control system are shown. Work is presently underway to refine the system, specifically its software, which includes complete primary processing and a directives language is being developed to improve communications between the experimenter and the system. Control modules to expand the functional capabilities are also being designed. Figures 3; references: 2 Russian.
[183-8225]

AN AUTOMATED QUALITY CONTROL SYSTEM FOR THE PRODUCTS OF A RADIO ENGINEERING ENTERPRISE

Kiev UPRAVL.YAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 79
pp 132-135 manuscript received 2 Mar 79

KORYTNAYA, L.A., KOCHERYKH, I.P. and SEMOTYUK, V.I.

[Abstract] Design requirements for standard automated quality control systems (TASK) are treated in light of experience with the development and introduction of one such systems at the Institute of Cybernetics of the Ukrainian Academy of Sciences and the L'vov Production Association imeni V.I. Lenin. A comprehensive quality control system should be at least a two level system: the first level should solve problems of monitoring production process operations and controlling them, where these require the processing of comparatively small volumes of data with relatively frequent changes in the corresponding algorithms when going from one product to another, or to the use of other materials and components; the second system level should provide for the solution of informational problems which require the processing of large volumes of data with comparatively infrequent changes in the processing algorithms. The overall system is represented in the form of a network of controlling automata which are automatic data transducers with program control. The requirements placed on these automata, as well as the control computers, are discussed and block diagrams are given for the functioning of the system and the interrelationship of its components. The following results were obtained with the introduction of a TASK system at the L'vov radio equipment plant: 1. The time needed to get series produced products in production was reduced from 1.5-2 years (1972) to 4-6 months (1978); 2. The mean time between failures of the products increased in 1978 by an order of magnitude over that for 1972; 3. The number of complaints and replacement claims dropped by 47.8% in 1977 as compared to 1972; 4. The volume of products awarded the State Seal of Quality increased from 52% in 1972 to 82.3% in 1977 relative to the total production volume subject to certification. Figures 2; references: 9 Russian.
[183-8225]

AN AUTOMATED INFORMATION RETRIEVAL SYSTEM BASED ON THE M-222 COMPUTER

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 79 pp 138-140 manuscript received 27 Sep 78, after revision 4 May 79

IVANOVSKIY, O.S.

[Abstract] An automated information retrieval system (AIPS), designed around the M-222 computer, was developed to provide specialists in an unspecified shipbuilding enterprise with timely data on ships. The SINKHRON (data storage, processing and accumulation system), developed in the Institute of Applied Mathematics of the USSR Academy of Sciences was used for interaction with the computer in the AIPS. The "Ship Modernization and Retrofitting" factographic card file on punched cards with two edge perforation was used as the original data for transfer to computer vehicles. The development of the AIPS as a component in the automated control system complex for the enterprise required the solution of the following problems: 1. The evaluation of the capabilities of the SINKHRON system, taking into account the requirements placed on the AIPS; 2. The development of a sample AIPS variant to determine the possibilities of refining the system; 3. The development of a complete set of AIPS programs which provide for operational input and accumulation of information, its retrieval and outfeed at the request of the user; 4. The estimation of AIPS efficiency (including economic) and the expediency of continuing work on the automation of information processes at the enterprise. The basic control component of the system is a dictionary which consists of definitions precisely describing the properties of the information data file. A sample calculation to justify the economic expediency of the system is adduced: the payback period for the capital investments is 4 years and outlays per ruble of final product are reduced by 3.55 kopecks where the annual income increase amounts to 72,800 rubles. Typical program run times with alphanumeric printout are: for the dictionary generator, 2.5-3.0 minutes; for making changes in one vessel, 2.5 minutes; report generator program for an entire dictionary (one vessel), 3 minutes; and a report generator selectively from the dictionary positions, 2.5 minutes. System operation for a year and a half has demonstrated its advantages over conventional information services for users and the promise for continuing the work on automating information processes. Figures 1; references: 4 Russian. [183-8225]

APPLICATIONS

FOUR COLLECTIVE-USE COMPUTING CENTERS IN TEST OPERATIONS

Moscow VESTNIK STATISTIKI in Russian No 3, 1980 pp 57-64

[Article by T. Ter-Israel'yan: "The First Collective-Use Computing Centers"]

[Excerpt] Four collective-use computing centers (CUCC's) are being established within the system of the USSR Central Statistical Administration to insure efficient use of computer technology and development of data processing procedures during the performance of tasks in the fields of accounting, planning, and management with a collective-use computing system. Three of the centers, in the cities of Tallin, Tula, and Tomsk were turned over for operation in 1979, and the Minsk CUCC will be turned over in 1980.

In view of the importance and timeliness of this problem, the editors of this journal organized a discussion for the purpose of showing the essential features of the CUCC's and how ready for experimental operations the first CUCC's set up in the system of the USSR Central Statistical Administration are.

The participants in the discussion were: D. G. Zhimerin, corresponding member of the Academy of Sciences USSR and first deputy chairman of the USSR State Committee on Science and Technology; M. A. Korolev, first deputy chief of the USSR Central Statistical Administration; V. G. Pronin, chief of the Main Administration of Computer Work of the USSR Central Statistical Administration; V. L. Ponomarenko, chief of the computing center of the Statistical Administration of the city of Tomsk; R. I. Pappel', deputy chief of the Estonian SSR Central Statistical Administration and chief of the republic computing center; A. A. Seregin, chief of the Tula sectorial information-computing center for state statistics.

(D. G. Zhimerin, corresponding member of the Academy of Sciences USSR and first deputy chairman of the USSR State Committee for Science and Technology)

The collective-use computing centers are the foundation of the State Network of Computing Centers being set up in our country. Plans for this system envision 200 basic CUCC's, which are being launched in operation by stages. Seven of the first-phase CUCC's are being set up in the current five-year plan, four of them based within the USSR Central Statistical Administration. These CUCC's are to work out the principles of using series-produced hardware and software, establishing information facilities, legal and organizational questions, and questions of relationships between the CUCC's and subscribers.

The formation of the CUCC's will make it possible to develop not just the principles of collective use of computer technology and new data processing procedures, but also to create the necessary stock of algorithms and programs, work out standard planning concepts, and the like.

In December 1979 the Interdepartmental Commission headed by Academician A. A. Dorodnitsyn accepted four CUCC's for experimental operation. These are the collective-use computing centers based on the Republic Computing Center of the Estonian SSR Central Statistical Administration, the Computing Center of the Statistical Administration of Tomskaya Oblast, the Tul'skaya Oblast Information-Computing Center of State Statistics, and the Main Computing Center of National Economic Planning and Management of the Latvian SSR.

General methodological guidance in solving the problem of setting up the AUCC's was provided at all times by the State Committee on Science and Technology and its All-Union Scientific Research Institute of Problems of Organization and Management. This made it possible to coordinate the efforts of all developers and formulate a standard detail design for the CUCC. It was a good decision to set up four CUCC's based at computing centers of the USSR Central Statistical Administration system. This is one of the most wide-ranging and high-powered computing systems in the country. It is organized on the administrative-territorial principle and encompasses about 2,900 computing centers and stations. The USSR Central Statistical Administration computing system has accumulated a great deal of useful experience in processing not only statistical but also accounting and other economic data for more than 90,000 enterprises and organizations. Therefore, organizations of this administration were exactly the ones who could handle the assigned job best.

The establishment and successful launching in experimental operation of the CUCC's confirms that it was correct to choose collective use of computer technology as the primary way to increase the effectiveness of its application to improve planning and management.

The new form of multifaceted use of computer technology insures organizational, informational, and technical uniformity among the automated control systems being set up in the country, and thus it creates the

basis for setting up a nationwide system for collection and processing of information for accounting, planning, and management. This shows clearly the advantages of the socialist system of management and the achievements of scientific-technical progress.

(Professor M. A. Korolev, first deputy chief of the USSR Central Statistical Administration)

The problem of setting up collective-use computing centers was included in the State Five-Year Plan for Development of the USSR National Economy in 1976-1980 as a key national economic, scientific-technical problem. The USSR Central Statistical Administration was commissioned to solve it during the current five-year plan.

The CUCC's that are being set up in our country for the first time are one of the basic promising organizational forms of using computer technology.

The USSR Central Statistical Administration system has long years of experience with work in the service of economic enterprises and organizations. It was actually the first to undertake comprehensive, systematic data processing for enterprises and organizations of various economic sectors which did not have their own computer capacities. This function will develop further on a new technical basis in the CUCC's, which will also perform computing work and provide information service to users in a remote data processing mode. The user who has only a terminal will receive access to the steadily growing computing capacities of the CUCC through communications channels.

The CUCC's will be the foundation of the State Network of Computing Centers being formed in the country. They will be assigned numerous interdepartmental problems in the fields of accounting, planning, and management.

The CUCC is a dynamic system equipped with the best computers, up-to-date auxiliary equipment, and remote data processing units.

The USSR Central Statistical Administration has expended a great deal of effort to solve the scientific-technical problems of setting up CUCC's. Each center received two YeS-1033 computers and more than 100 units of other equipment. Through joint efforts practically all contemporary operations systems and remote processing systems, plus packages of applied programs, were mastered. Special programs were prepared or incorporated to solve subscriber problems. The CUCC's serve between 18 and 33 subscribers in the subscriber network. The centers solve 100-200 problems for them. Many of the problems are multifaceted standard problems, that is, they can be introduced at other CUCC's virtually unchanged.

The CUCC is a complex data processing enterprise with good technical equipment. It will function on cost accounting principles. The technical-economic effect from the functioning of a CUCC will be, according to calculations by the Scientific Research Institute of the USSR Central Statistical Administration, 2.4-3.0 million rubles a year per center. The payback period on capital investment is about 2.5 years.

Experimental operation of the CUCC's will make it possible to solve the following basic problems:

- a. work out technology and standard data-processing concepts to solve problems in the fields of accounting, planning, and management in a collective-use (time-sharing) mode;
- b. demonstrate that the method of collective use by enterprises and organizations regardless of their departmental affiliation permits more efficient loading of computer technology and makes it possible to reduce the number of local computing centers in the country;
- c. organize information service for different categories of users (subscribers) through the formation of automated data banks.

The establishment of collective-use computing centers is very important for the continued development of state statistics. This new form of organization of computer technology will make it possible to strengthen the technical base of this system and introduce fundamentally new technology for processing statistical data. With remote data processing equipment at their disposal, agencies of the Central Statistical Administration can receive essential information from enterprises and organizations at almost any moment. Moreover, the availability of the data bank offers an opportunity for broad use of mathematical economic methods of analysis, which will help agencies of the Central Statistical Administration use modern computer hardware and communications equipment better and fulfill their plans for mechanization and automation of accounting and statistical work. Therefore, statistics is being given a technical base appropriate to the current stage of development of economics.

(V. G. Pronin, Chief of the Main Administration of Computing Work of the USSR Central Statistical Administration)

Within the system of the USSR Central Statistical Administration, the Main Administration of Computer Work has been assigned to direct work on the establishment of the CUCC's. The Scientific Research Institute of the USSR Central Statistical Administration will perform the functions

of head organization for solving the scientific methods problems of setting up the CUCC's, and the organization responsible for development of technological procedures and software for subscriber problems at the CUCC's is the All-Union State Design-Technological Institute for Mechanization of Accounting and Computers of the USSR Central Statistical Administration.

It should be stressed that the CUCC's will also be the foundation of the State Network of Computing Centers on a nationwide scale and the most modern technical facilities in the Automated System of State Statistics. Taking advantage of the experience of the first AUCC's, measures are envisioned by the USSR Central Statistical Administration following from the decisions of the 25th CPSU Congress on further refinement of the state statistics system, to set up similar centers on the basis of other computing centers of the Central Statistical Administration System in the future. In other words, the network of CUCC's will be expanded.

Putting the CUCC's into operation will offer an opportunity for a qualitative improvement in providing management and planning agencies of the republics, oblasts, and cities with the information needed to manage the national economy. It will also make it possible for a large number of enterprises and organizations to use the capacities of the CUCC's more fully.

The first phases of the CUCC's in Tallin, Tula, and Tomsk were turned over in conformity with technical specifications for the establishment of CUCC's in these cities to the extent of start-up complexes. These complexes include hardware, programs, information, procedural, organizational, legal, and other CUCC support facilities. The start-up complex overall can serve 71 subscribers.

Among the subscribers to the first phase of these CUCC's are: the Council of Ministers of the Estonian SSR, oblast and city committees of the CPSU, oblast and city executive committees of Soviets of Workers Deputies, enterprises and organizations under both USSR and USSR-republic ministries and departments. The AUCC's are expected to provide them with solutions to problems related to comprehensive territorial development (oblast and city automated control systems) for territories included in the ASOIDO (expansion unknown), Automated System of State Statistics, Automated System of Planning Calculations, Automated Control Systems for Municipal Services, and other subsystems, as well as problems related to automation of management of industrial and agricultural enterprises.

The technical base established to launch the first phases of the CUCC's Tallin, Tula, and Tomsk includes the following: six YeS-1033 computers with main memory capacities of 512 kilobytes apiece. The external memory of the machines at each CUCC is on the order of 500 megabytes.

The computers are joined into computing complexes. The CUCC's have received 147 different units of remote data processing equipment. In addition, the CUCC's in Tula and Tallin have set up YeSTYeL-2 (Bulgarian) remote data processing systems. All the CUCC's have the necessary personnel to operate this equipment. All the equipment at the CUCC's had for the most part been put into operation when the facilities were turned over.

All the subdivisions of the USSR and Union Republic central statistical administrations in which the first CUCC's will function prepared actively for their acceptance. Together with the State Committee on Science and Technology they developed procedures, programs, and techniques for testing when the first phase of the CUCC was turned over; organizational measures on preparation of the CUCC's in the cities of Tallin, Tula, and Tomsk to be turned over to the departmental and interdepartmental commissions for experimental operation were ratified. Planning documents were ratified, including the hardware of the CUCC's and subscriber points, data processing procedures at the CUCC's, the subscriber network for data transmission and communications channels, information facilities of the CUCC's, and CUCC software.

Despite the fact that the CUCC's are universal in the functions they perform, which is to say that they can handle the most diverse subscriber problems, already in the first phase they have shown signs of becoming oriented to particular types of problems.

(V. L. Ponomarenko, chief of the Computing Center of the Statistical Administration of Tomsk)

The Tomsk CUCC is the technical base for formation of the automated control system for the oblast economy. It is oriented to solving problems of accounting, planning, and management for the economy of Tomskaya Oblast.

The CUCC in Tomsk was prepared for turnover in conformity with measures ratified by the USSR Central Statistical Administration. When the CUCC was being turned over for experimental operation tests were run on the complex of hardware and communications channels, software, information facilities, and data processing procedures as a whole under real conditions of operation for a CUCC and subscriber network.

When the CUCC was turned over to the Interdepartmental Commission the hardware complex was delivered and launched. The subscriber points and computers were linked up and the first phase of the communications channels was put into operation. Subscribers use both switchable and non-switchable communications channels. The Tomsk CUCC in its first phase will serve 20 subscribers.

At the moment of turnover the CUCC was operating six functional subsystems with a total of 96 problems. Among them were an automated data processing system for management agencies which includes 45 problems. Of these 45 problems, 12 are now in the stage of industrial use (the subsystem "MONITOR"), 11 are in experimental use (the automated information system "LETTER"), 12 are in the detail design stage (the automated information system "DOCUMENT"), and so on.

The problems of the start-up complex are run in three modes: batch, remote batch, and query-response.

At the present time data bases for the problem areas "Industry," "Capital Construction," and "Agriculture" are being developed as part of the automated data bank of the Automated System for State Statistics.

Experimental operation of the automated data bank under control of the "OUTCOME" data bank control system will be started soon, but at the present time the experimental automated data bank is controlled by the "OKA" data bank control system. The official descriptions of the territorial units of the oblast make up the information fund of this data bank. At the present time information has been collected and fed to the computer for all 16 rayon centers of the oblast.

Technological procedures envision four ways for information to go through the CUCC: processing of information received on primary documents; processing of information received on technical media; processing of information arriving by communications channels to an intermediate medium; processing of information fed directly to the computer by communications channels.

I would like to emphasize that the job of comprehensive debugging of equipment and system software was done very slowly. Because the launching-debugging organizations do not perform comprehensive debugging of equipment and do not have programs that support the operation of remote processing equipment together with the computer, the remote data processing equipment at the CUCC was very difficult to launch and this had to be done chiefly by specialists of the CUCC.

Despite these difficulties, however, the first phase of the Tomsk CUCC was turned over to the departmental and Interdepartmental commissions for experimental operation at the proper time.

(A. A. Seregin, chief of the Tul'skaya Oblast Information and Computing Center of State Statistics)

The first phase of the CUCC in the city of Tula, which is being formed by integrating computer hardware, is designed for multifaceted service to enterprises and organizations that do not have their own computers. The CUCC in the city of Tula will provide information service and

computer work for industrial enterprises as well as enterprises in the nonproduction sphere. Particular note should be taken of work for local management and administrative bodies, for which oblast and city automated control systems will be formulated using CUCC hardware and software.

The CUCC can be compared figuratively to industrial production of processed information, significantly surpassing local computing centers with respect to efficiency.

The considerable list of services offered to CUCC subscribers in the remote processing regime permits a new approach to the question of using computer technology. The formation and operation of CUCC's will make it possible to test not just the principles of collective use of computer equipment but also organization of automated data banks. This will permit us to develop standard planning decisions in the fields of hardware, software, and methodology, and will reduce the time and expenditures required to develop and use software both at the CUCC and with the subscribers.

The subscribers of the first phase of the Tula CUCC included 18 enterprises and organizations, for whom up to 200 jobs will be performed. When the center was turned over 68 percent of them were in the stages of experimental or industrial operation; remote data processing is envisioned for all problems.

The CUCC in the city of Tula is based on two YeS-1033 computers aggregated at the external memory level. We will try to set up a machine complex with common system entry and exit queues, which will significantly enhance the possibility of solving the problem in the given time interval. The technical facilities and software that have been developed make it possible to organize the technological procedure for data processing with broad variations.

In the first phase of the CUCC the subscriber is able to receive and send information through communications channels. The diversity in organization of the processing procedure makes it possible already to choose technology which best meets the demands of operational flexibility and efficiency and provides the most convenient mode of functioning for the subscriber.

One of the new services that distinguishes the CUCC from local computing centers is organization of an information reference mode that can be carried in two sub-modes, called "reference dialog" and "query-response."

The large volumes of information necessary to handle the problems of CUCC subscribers and the limited configuration of hardware in the stage of building the first phase of the CUCC in Tula made it necessary to integrate the problem files of subscribers and establish a

single structure for the data base and control. The automated data bank "Statistics" was developed for this purpose. The "Oka" and other program packages have been tested and are going through experimental operation.

The automated design system with information reference based on a single data bank, archives, and design software and offering the possibility of representing output information in graphic form is especially interesting.

The establishment of a computing medium with such power in hardware and software will permit us to take a new approach to our traditional work as a state statistical body. It offers great promise for providing management bodies with information directly from data banks. The operational flexibility of data representation will increase significantly, and this is one of the key conditions in management work.

The first experience with operations on the new system is positive. The technology is plainly efficient, as is the CUCC as a whole. For example, the calculated economic efficiency for solving problems in just the first phase of the CUCC is 2.4 million rubles. At the same time, use of the new technology has revealed fundamental shortcomings and difficulties with incorporation of the general software and building the hardware of the CUCC. Most of the finishing touches for both software and hardware had to be done in a very limited time with personnel from the CUCC.

(R. I. Pappel', deputy chief of the Central Statistical Administration of the Estonian SSR and chief of the Republic Computing Center)

Work to turn over the first phase of the CUCC in Tallin for experimental operation was intensive in 1979.

When launched the Tallin CUCC will provide multiple services for enterprises and organizations that do not have their own computers and provide information service and computing work for local management and administrative bodies solving particular problems in a remote processing mode. The list of subscribers for the first phase of the CUCC in Tallin includes 35 enterprises and organizations, seven in the production sphere and 28 nonproduction. This includes 16 organizations in the system of the Estonian SSR Central Statistical Administration (all the rayon information and computing centers of the republic). The start-up complex of the first phase offered 144 problems for the national economy, 31 of them using remote processing equipment.

Work progress in preparing to turn over the CUCC was reported on monthly at the board of directors of the Estonian SSR Central Statistical Administration and was a focus of attention for the party, trade union, and Komsomol organizations.

The hardware consists of four computers, two YeS-1033's, one YeS-1030, and YeS-1022. Three of them are joined in a single machine complex with shared memory. At the present time some of the remote data processing equipment is in operation: AP-4 subscriber points, the YeSTYeL-2 (Bulgarian) remote data processing system, AP-2 subscriber points, and AP-61, AP-63, and AP-64 displays.

Unfortunately, incomplete and delayed delivery of equipment created great difficulties in putting together the subscriber software developed by the CUCC and planning organizations on time.

The Tallin CUCC is unique in the republic. It is the first time a multiple machine computing complex has been formed using a laser system for one of the communications channels.

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TEST RUN FOR PROCESSING CENSUS MATERIAL MADE IN BELORUSSIA

Moscow VESTNIK STATISTIKI in Russian No 3, 1980 pp 42-43, 57-64

[Article by L. Kosukhin: "The Job Is Done"]

[Excerpts] In order to master the procedure of machine processing of the census and acquire practical skills in feeding data from census sheets to the computer, so-called "rehearsals" of each operation of the procedure were conducted with data received from the Central Computing Center of the Central Statistical Administration of the Belorussian SSR from the 1976 sample census and from census sheets filled out during the period of training counters at the rayon (and city) information and computing stations and centers. The results of the "rehearsals" were analyzed to identify tight spots in the procedure for processing census sheets and to outline steps to eliminate problems.

In addition, the group computing center (Republic Computing Center of the Central Statistical Administration of the Belorussian SSR) and the Census Division of the Central Statistical Administration sent the statistical administrations of the oblasts and the city of Minsk comments on preparation of census sheets for machine processing, calling special attention to strict compliance with the instructions of the USSR Central Statistical Administration on filling out census documents and on the quality of graphic marking. All this made it possible to master the standard procedures of operating system OS 4.1 before work began and to test and introduce several "versions" of software for machine processing of census data; it also enabled computer technical servicing specialists to organize technical service for the new blank-P device and get the YeS-1022 computer working reliably. Specialists from the Central Computing Center of the USSR Central Statistical Administration were very helpful in preparing the group computing center for machine processing of census materials. They visited the group center several times and helped with mastering the technological procedure and software for census work and with organizing technical service for the computers.

Machine processing of census sheets at the group computing centers consists of two basic stages. The first stage, which is the largest in scale and most labor-intensive, involves the following: feeding data from census sheets to the computer; formal monitoring and formation of the codes of the characteristics of the information fed; formation of logical entries; counting control numbers (actual number of portfolios, census sheets, number of persons); counting deviations of actual number of census sheets and number of persons from corresponding indexes of the blank — inventorying the portfolio, recording mistakes found on census sheets, and entering the information on persons counted on a magnetic disc; determining the absolute magnitude of the tolerance by number of errors; correcting information — removing that information which was corrected from the magnetic disc, feeding census sheets with corrected information, and entering on the magnetic disc; making three copies of the information recorded on the magnetic tape, checking, assembling, and sending this information to the Central Computing Center of the USSR Central Statistical Administration.

In the second phase the group computing center obtained tables with the results of the full census by administrative regions, cities (with the exception of oblast and republic centers), urban-type communities, and large towns from magnetic tapes received from the Central Computing Center of the USSR Central Statistical Administration.

The initial processing of material from the 1979 All-Union Census was done with a YeS-1022 computer in the expanded version equipped with two printers, a YeS-7032 and a YeS-7033, two YeS-7077 console typewriters, four YeS-5061 magnetic disc stores, and eight YeS-5017 magnetic tape stores. An interlinking device, an AD-2153 adapter, and two Blank-P counters, were added to feed data directly from census sheets to the computer and make entries on magnetic tape. Specialists from the division of computer technical servicing organized mechanical operation and maintenance of the hardware used to process census materials and kept it in working condition.

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MINICOMPUTERS IN STOCK MANAGEMENT

Moscow MEKHAIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 2, 1980, pp 41, 42

[Article by A. N. Rodnikov, engineer: "The use of the minicomputer for stock management"]

[Excerpts] In small enterprises of trade and material and technical supply the adoption of automated systems for stock management involves certain difficulties. One of these is the long actual and planned time it takes to recoup the expenditure. In recent years a wide variety of ASU's (automated systems of control) have been developed for production as well as non-production areas, based exclusively on mini-computers. Specifically, such systems were displayed in June-July 1979 at the exhibit at the VDNKh (Exhibition of the Achievement of the National Economy) called "The Unified System Computer and System of Mini-computers and their Use."

The SIMAG ASU with warehousing processes was developed in the Scientific-research Institute of Computer Technology "UTS" (Bucharest), was displayed in the Romanian division of the exhibit. The main purpose of this system is to keep accounts of the stock of raw and other material stored in a warehouse and on this basis to facilitate the realization of the production plan of the enterprise. The system has at its disposal a large number of programs for obtaining data on the flow of material in various sections for any interval of time. A portion of the programs add an operating system for the creation of a data base with files, the structure of which is specific to warehousing services. The first file contains codes for the stock stored in the warehouse, the second--quantitative data on stocks and locations they are stored in, the third is input codes of the designations and prices of the stock of products, the fourth has arrival outlay documents. It is planned to issue the resulting information in part in the following forms: calculation of the work load of the warehouse departments, calculation of free cells, enumeration of the stocks of materials in a given department, enumeration of the departments where stocks of material of a given designation are stored, full enumeration of the stored stocks of materials, enumeration of arrival and outlay of materials during a given period.

The SIMAG system uses the "I-100" mini-computer (of Romanian Production) with a working memory capacity of 64K, which includes the following peripheral devices: display, operator's console with a teletype interface, card and tape readers, key punch, printers (mosaic and drum), magnetic tape storage devices etc. The presence of a wide range of peripheral devices makes it possible to develop various configurations. An important feature of the SIMAG system is the fact that it can use the SM-3, SM-4 and PDP-11 mini-computers.

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THE USE OF COMPUTER COMPLEXES TO AUTOMATE THE CONTROL OF TRANSPORTATION PROCESSES

Minsk MEKHAIZATSIIYA I AVTOMATIZATSIIYA UPRAVLENIYA in Russian No 1, 1980
manuscript received 22 Jan 79 pp 27, 28, 29, 31

[Excerpt from article by Yu.S. Ligm, candidate of the engineering sciences, V.Ye. Sutnikov and L.N. Shtunder, engineers]

[Excerpt] The following processes are being automated at the present time in motor vehicle transportation: The compilation and monitoring of the traffic schedule, the selection of dispatcher control actions for the elimination of disruptions in the schedules for passenger motor vehicle transportation, the calculation of the daily shift schedule chart for each rolling stock unit (PYe), monitoring the departure from the ATP [motor vehicle transportation point] and arrival at the load assembly facility, monitoring the execution of the schedule chart for the performance of technical servicing, and repair of the PYe - for the freight.

An automated system for dispatcher control of bus shipments (ASDU-A), intended for operational control of traffic, has been developed for this purpose for passenger motor vehicle transportation. The purpose of the design of the ASDU-A is the improvement of the quality of municipal bus transportation service for the populace and increasing the efficiency of the utilization of the rolling stock.

The ASDU-A includes the following subsystems:

—Operational control of the bus traffic, which realizes the gathering and processing of data on the travel of PYe's along the route; monitoring the execution of the traffic schedule for the PYe's on the routes; control of PYe traffic in the case of deviations from the schedule, in the case of departures and overcrowding on the routes; the receiving, processing and transmitting of information by the dispatchers of the TsDS [central traffic control service];

—Dispatcher reporting and analysis of shipments, which provide for the accounting and analysis of the technical operational indicators of the

shipping process and statistical data on the transportation process;

— Monitoring the functioning and assuring operation of the system without shutdowns, which provides for the restoration of the system following a breakdown and the determination of the technical condition of the units being monitored.

The ASDU-A software consists of the general and special software. The general software takes the form of a set of algorithms, programs, descriptions and instructions which are intended for the automation of the development of ASDU-A program software, the organization of the monitoring and control of the computational process during the realization of system functions and is determined by the type of M-6000 computer complex. The special software consists of the programs which realize the system functions.

A computer complex designed around the M-6000 universal computer, which is coupled via telephone communications lines to four UKP's [monitor point devices] has been installed at the TsDS located in Kiev Motor Vehicle Passenger Transportation Administration.

During the 10th Five-Year Plan, ASDU-A systems should be placed in service in Kiev, Donetsk, L'vov and Simferopol.

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ASU IN CITY MANAGEMENT: DIRECTIONS AND EFFORTS

Moscow ZHILISHCHNOYE I KOMMUNAL'NOYE KHOZYAYSTVO in Russian No 12, 1979 pp 19-21

[Article by Yu. A. Andryukhov, special correspondent]

[Text] Is the creation of automated control systems efficient in urban management? It would still be difficult to answer this question unambiguously in the 10th Five-Year Plan, since experience in use of such systems is inadequate. We know today that the annual economic effect from incorporation of a single urban management (GKh) ASU is over 1,000,000 rubles, while expenditures are paid back in less than a year.

In developments of the GKh ASU in our country, already more than 100 organizations have taken part. The leader among them is the Moscow Scientific-Research and Planning Institute of Automated Control Systems in Urban Management (MNIPI ASU GKh) of USSR Minpribor.

The institute began operating in 1971. In the USSR Minpribor system, it is defined as a leading organization in the creation of ASU in urban management. It has been entrusted with conduct of scientific research and development of construction principles of ASU for major cities; together with organizations of Mosgorispolkom to create ASU for sectors and enterprises of urban management; to promulgate standard planning solutions (TPR) based on ASU prepared for Moscow, and also standard mathematical software for ASU; and finally, to render methods assistance to sectors in incorporating ASU in the capital.

The institute developed 43 automated systems, and in three years of the current five-year plan has carried out 2.2 times more work than in the entire 9th Five-Year Plan. In ASU plans the number of problems is continuously rising, mainly outlook ones such as optimization, prognosis, analysis and quality control. In ASU developments of 1975 were an average of 10 problems, whereas in 1976 there were 18 and in 1977, 21 problems. The number of outlook problems in 1978 as compared with 1975 rose from 35 to 60 percent. Simultaneous to the rise in the number of problems is their quality, expenditures for their creation decreases. Thus on the basis of work assuring scientific-research work in preparation of a single problem, expenditures in 1975 were 39,000 rubles, in 1976—20,500 rubles, in 1977—14,500 rubles, and today this indicator has dropped to 10,000 rubles, i.e., to almost one fourth of its initial value.

Economic effectiveness and scientific-technical level (NTU) of developments and activity of MNIPI ASU GKh are continuously growing (see table).

Scientific-technical level of ASU is an indicator of quality of developments. It expresses the level of the functional portion of the ASU, organizational, technical and information-programming software and economic effectiveness. And the institute team is proud of its continuous growth.

Indicators	years			
	1975	1976	1977	1978
Volume of work, thousand rubles	3322	3362	3291	3091
Volume of work per coworker, rubles	3798	3886	3956	4014
Economic effect in calculation per worker, rubles	4700	7858	11,400	22,992
Economic effect of ruble expended, rubles	1.37	2.27	3.12	6
Scientific-technical level (NTU) of ASU, balls	7.1	7.1	8	8.5



Computing Center of Main Administration of Trade of Mosgorispolkom. One of the base ASU was created here.

What problems can the systems created by the institute resolve?

For the construction sector, the institute prepares ASU-Promstroy, ASU-Zelenogradstroy, ASU-Inzhstroy and others in which problems of optimization of capital investments, capacity planning, operational control of material deliveries are solved.

In 1978 the first phase of the automated control system of Glavmosinzhtroy was incorporated at Mosgorispolkom, consisting of two subsystems and 18 problem complexes. In the subsystem "Technical and economic planning" are prepared detailed descriptions of the industrial process of the construction program of the central board, a summary calendar plan of work for the year is formed, periods of facility opening are marked in terms of kinds of structures, by years and quarters, graphs of distribution are drawn up for basic labor and technical resources of the central board according to quarters, central board requirements for basic material resources for the year are compiled, volumes of construction of the annual program of the central board are distributed to trusts and construction-assembly work of trusts according to quarters, needs are determined for construction equipment, labor resources and materials.



The institute and its planning and design bureau use six computers. Laboratories and divisions have modern organizational technology. Institute operation management is automated.

The subsystem "Operative monitoring and control" puts out information on the course of construction of facilities by kinds of work, status for a specific number, signal information in critical deviations from the graph.

The ASU permits optimization of plans of construction production, maximum concentration of capacities of the central board, efficient use of material resources and assurance of rhythmic setting into operation of facilities, and reliable monitoring of the course of work.

In the sector "Health care and environmental protection", the institute incorporated nine ASU, including a "Sanhygiene" system for Mosgorses. It was

created on the basis of functions of Mosgorses in the field of environmental protection at enterprises and in the city. Based on research, health offices prepare requirements and recommendations for normalization of the content of toxic substances to a level of the maximally acceptable concentration (MAC). After carrying out health measures, their hygienic effect is determined: the state of the air in production is tested. This monitoring and normalization is done to prevent occupational intoxication and disease and preserve the health of workers.

When the ASU was created, the goal was set to reduce the number of occupational diseases at industrial enterprises, and also free experts from routine data processing and compilation of various information and reports required for decision-making.

The system is composed of three basic problem complexes. The first is "Analysis of concentration of toxic substances and dust in the air" and permits evaluation of the concentration of toxic substances and dust based on the nature of technological processes, efficiency of ventilation, temperature conditions, time of sampling for 73 substances, with isolation of substances of the first and second degree of danger. The complex "Analysis of activities of laboratories of sanepidemic stations and enterprises" permits monitoring of their operating plans and evaluation of activities of laboratories by the number of analyses per reporting period. In the complex of problems "Analysis of utilization by laboratories of various methods of analysis of toxic substances and dust in the air" the quality of work of the health service is in essence evaluated.

The ASU-Sangigiyena works as follows. All laboratories must present Mosgorses with the coupons from sample cards (Form No. 051) on the 10th day of the month after the reporting period. Then before the 15th of the month they are presented to the computing center where they are transferred to computer carriers and the data are stored in computer memory. Upon request the computer can put in several minutes a list of information which is also used as a basis for decision-making. The system makes it possible to obtain several dozen response variants. In the period of operation the ASU has processed about 400,000 documents. A similar system is also incorporated in Kiev.

The institute now includes the Kishinev and Vilnius PKB. In 1978 the latter planned the ASU for water channelization management for Moscow, Leningrad, Kharkov, the Latvian SSR and is preparing similar plans for Minsk and Riga.

ASU-Vodokanal of the Latvian SSR includes eight subsystems: technical and economic planning, operational control, bookkeeping accounting and statistical reporting; analysis of industrial management activities, personnel management, customer accounts, material and technical supply and standards information. The annual economic effect averages about 1,500,000 rubles per system. It is achieved because of improvement in administrative management and incorporation of modern methods of planning, accelerated collection and processing of information, decision-making on the most efficient course of management, detection and realization of reserves of energy economy, reagents and water, timely conduct of preventive maintenance of networks and struc-

tures, arranging accounts with customers.

Experience in creating sector systems will make it possible for the team to elaborate regional ASU. The first step in this direction was the automated information system (AIS) of the Kuntsevo region of Moscow. Its distinctive feature is the combination of goals of sector and territorial management. This system consists of 12 subdivisions in which 56 problems are realized. Incorporation is being carried out in stages. In the first stage the subsystems are debugged and the achieved level of service to the regional population is considered and analyzed (performance of the plan in construction, welfare, collection of scrap metal, secondary raw materials and food wastes, results of competition are cited). In the subsystem "Management of living fund" is recorded and processes information about rents and tenants. In the themes "Road construction, welfare and community services" and "Trade management" are solved five problems.

In the second phase of AIS will be solved problems of operational control and monitoring, planning and regulation of regional budget, health care, culture and construction.

It is anticipated that annual economic effect from incorporation of this information system will be about 1,500,000 rubles. It will be achieved because of a reduction in supernormative reserves, increased volume of services, rendered in the region, redistribution and improvement of resource utilization.

Elaborations of the institute have been repeatedly demonstrated at VDNKh SSSR. For its participation in expositions in 1978 alone, 25 coworkers of MNIPI ASU GKKh were awarded exhibition medals. Four systems created by the institute were recently demonstrated at the International Specialized Exhibition of Computer Technology in Moscow.

In the course of its activities, the institute has created base ASU which have a high level of standardization of planning decisions and which assure incorporation of these systems at similar facilities. In 1978, six systems were conveyed to the Central Fund of ASU Algorithms and Programs (TsFAP ASU) in Kalinin as applied program packages (PPP), including ASU-Prodorg, ASU-Promtorg, ASU-Sangigiyena, ASU-Flyuorografiya, ASU-Inspektsiya, hence interested organizations can obtain them by contract.

In view of the growing interest in automated management of urban management, great value is being acquired by the question of work coordination. Jointly with organizations of Mosgorispolkom and nonindustrial sectors at which the institute creates ASU, joint coordination plans have been compiled, financing sources and basic elaboration trends have been revealed.

The institute is carrying out elaborations based on contracts. Thus even more attention is paid to preparation of scientifically valid long-term joint plans with sectors and cities. Acceleration of incorporation of new methods of management will be served also by methods elaborations, including general sector materials on ASU design for urban management.

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ASU'S IN BYELORUSSIA

Moscow MEKHAIZATSIYA I AVTOMATIZATSIYA PROIZVODSTVA in Russian No 3, 1980, pp 24-26

[Article by N. I. Novitskiy and V. G. Ivanov; Engineers: "The Efficiency of the Functioning of ASU's in the Enterprises of Byelorussia"]

[Text] Automated system of control (ASU's) at various levels of the hierarchy of management of public industry represent the most effective form of computer use and application of economic-mathematical methods for management improvement.

Toward the end of the tenth Five Year Plan about 300 ASU's will be operating in the enterprises of Byelorussia. This will make it possible to bring the level of mechanization of accounting/computational and planning work up to 80%. Without a doubt, the development and introduction of ASU's on such a large scale requires a study of the efficiency of their functioning. Although data from national and foreign experiences testifies to the high efficiency of the use of computers in economic management, it is also well-known that the creation and introduction of an ASUP (Automated system of control of an enterprise) requires substantial capital expenditure and that some of them are not very efficient, or even are completely unprofitable. For this reason, the search for ways to obtain the best results from the introduction of ASU's is extremely urgent.

An analysis of the ASU's introduced in 1975-77 in a number of enterprises in various sectors of industry in Byelorussia was performed. This analysis was performed from the point of view of production and operation.

From the point of view of production ASU's are considered as production projects in the designing organization. In this regard attention is primarily focussed on the labor consumption and amount of time required to develop and introduce ASU's. In addition, they have studied the economic efficiency of the systems in the developing organizations. Results of the analysis showed that the average time to create the systems was 3.5 years. Of all the systems considered, 19% were created in two years or less, 13% in 2-3 years, 48% in 3-4 years and 20% took more than 4 years. For

example, the ASU of the Gomel'mash took 4.5 years to create and the ASU of the Minsk motor plant took 5 years. It is unacceptable for an ASUP to take more than 4 years to create as this lowers the efficiency of the amount spent creating them.

A large amount of work is being done to lower the labor consumption and required time for the creation of ASUP's. For example, at the present time in TzNIITU (Central Scientific Research and Design-Technological Research Institute for the Organization and Technology of Control), they have corrected and republished a directive "Norms for labor consumption and time required," according to which the labor consumption for the creation of an ASUP is lowered to 5-10 thousand man-days, depending on the size and complexity of its functional component; while the time spent creating the system must not surpass 3-3.5 years. The savings to the developing organization attributable to the development of the system is figured per one ruble of expenditure. The analysis shows that the mean savings per one ruble of expenditure on the introduction of systems into Byelorussian enterprises is 1.29 rubles, and for some ASUP's significantly higher than the average for all systems studied. In the near future it is believed that this figure will reach 2-2.5 rubles.

From the operations standpoint, the analysis was performed on the following groups of indicators: the make-up of the functional subsystem and control tasks; the level of all types of support; support of the ASU by work forces; study of changes in technical/economic work indices of the enterprise when the ASUP is functioning; level of savings attributable to the system.

In the process of analysis of the subsystems and tasks of the ASU's functioning in the enterprises of the republic, it was revealed that on the average they consist of six subsystems and solve 50 control tasks (Cf. Table).

ASUP	Number of Subsystems			Number of Tasks		
	Put in by Developer Organizations	Developed by Enterprises Themselves	Total	Put in by Developer Organizations	Developed by Enterprises Themselves	Total
Minsk automobile plant	2	2	4	9	33	42
Minsk machine-tool plant imeni S. M. Kirov	4	2	6	23	33	56
Gomelsk trigger motors plant	6	0	6	36	5	41
Gomelsk agricultural machine-building plant	6	1	7	31	32	63
State bearing plant No 11	5	3	8	31	42	73
Minsk automation lines plant	5	0	5	36	27	63
Minsk electrical engineering plant imeni Kozlov	5	0	5	25	16	41
Minsk meat combine	5	0	5	24	8	32
Orshansk production association "Promshveymash"*	5	2	7	18	27	45
Minsk refrigeration plant	5	2	7	18	27	45
Average for one system	5	1	6	27	23	30

*Minlegpishchemasha

As the table shows, in many enterprises they are working on the introduction of new control tasks into the subsystems developed by the developer organizations as well as in newly created ones. In some enterprises, the number of tasks performed has increased 1.5-2 times in comparison with those developed for the design.

The most widely used subsystems in the ASUP's studied were the following: technical economic planning, operative control of primary production; control of material and technical provisions; control of technical preparation for production; control of sales, bookkeeping.

The subsystems of management of norms, quality control, control of work forces, and organization of control of ancillary production are used to a lesser extent. It was established that for any of the subsystems named the ASUP implemented only the simplest and most traditional in content of the control tasks, automatizing the execution of accounting and bookkeeping operations. For example, a more detailed study of such subsystems as the operative control of primary production, which is so important because of its influence on the technical-economic indicators of the activity of the enterprise, shows that it, as a rule, is represented in the following tasks: calculations of the component by component plan by enterprise and shop, calculation of the operational plan for delivery and receipt by each shop, operational recording of fulfillment of the plan for intershop shipments and fulfillment of the plan by shops and sections by product name and amount per day, calculations of equipment load, operational recording of down time of machine tools etc. Furthermore it is well known that the contribution of the indicated tasks to the general impact of the subsystem does not exceed 35% while 65% of the potential impact from the introduction of the given subsystem is provided by the unutilized tasks such as operational control in real time, calculation of daily assignments for shops and component by component plans per section, optimization of scheduling norms, and dispatcher control of production. Thus, it can be said that the given subsystem is operating at only a third of its capacity.

In the material-technical provision subsystem the computer primarily solves problems in determination of demand and calculation of materials in the warehouses of the plants. Problems involving regulation and determination of the optimum level of stocks of materials are absent in the analyzed ASUP's. We could give more examples. Moreover, the ASUP's of Byelorussia have other shortcomings: the problems solved primarily involve the upper levels of management--51% of all the problems are solved at the level of the enterprise, 38% of the shop and 11% of the section.

It is also essential to note that in some enterprises certain tasks of the subsystems in operation are not performed at all and others are completed by the workers of the enterprise themselves. In the process of analysis, it was revealed why the tasks were not executed or required completion.

The most frequently encountered reasons for lack of execution of programmed tasks included lack of organizational provision (the problem of filling out input documents was not solved, the customer makes new requirements for input or output documents, 30% of all the unsolved problems are non-functional); a great deal of work is required to prepare the input information (25%); lack of technical documentation and information about norms, suitable for the creation of NSI (Reference information on standards) files (15%); errors in the posing of problems and lack of software (12%), tasks which depend on information from other unperformed tasks (12%).

Less often the tasks of a subsystem are not performed because of the length of time it takes to compute them and also because of the particular characteristics of the individual production etc.

Causes leading to the necessity for completing the solution to tasks include: change (complete or partial) or introduction of supplementary forms of documents for the output information (32% of all problems); completion by hand of the solution algorithm in order to cut down on solution time (28%); introduction of additional information, not provided for in the original project; change of form of the input information documents because they are so time consuming to fill out (7%); problems completed by hand to coordinate them with others (12%).

The results of the analysis have been intensively studied by development organizations and will be taken into account in the creation of new systems.

In the process of analysis at the level of all forms of support (hardware, software, informational and organizational) we established the extent of correspondence between the analyzed indicators and the projected ones, discovered the reasons for discrepancies and their nature, and also the degree of their influence on the efficiency of the functioning of the ASUP's.

The analysis shows that the hardware of the ASUP's studied is principally built on the basis of second generation computers, among which the most widely used are computers of the type "Minsk-32" (90%). Several enterprises use computers of the YeS-1020 types, models ASVT (Modular system of computer technology) M-5000, M-6000. For collection and recording of production data they use the series peripheral hardware devices of the type RP-10, RP-50, RP-100, invoice machines FM-346P, invoice-bookkeeping machines "Iskra-2301," "Zoyemtron-383," dispatcher installations ARP-114 and equipment for calculating output.

As a rule, the information processing-computer centers of an enterprise, as was foreseen in the plan, are equipped with one or two complexes of "Minsk-32" computer, and have on the average 10-12 peripheral devices of the RP type. The average daily load of the computer in functioning ASUP's is 13.4 hours instead of the necessary 14-18 hours. The incomplete load of the computer is a consequence of their weak concentration, lag in development of the most complex programs for the calculation of yearly and prospective plans and operational control of production, the limited capacities of peripheral hardware, absence of a work mode which facilitates direct access to the computer. All this, as a rule, lowers the efficiency of the functioning of the ASUP. At present, as is well-known the output of third generation computers is growing, including RI (expansion unknown) type peripheral devices for processing data. As the hardware base develops the efficiency of the ASUP should increase to a significant extent.

The results of the analysis of software shows that in all the enterprises studied the basis of the software systems is the program library developed using ISE-2 in COBOL and, for the solution to some problems, a symbolic coding language (YaSK). The use of applied program packages (PPP) for general system use (including, those executing tasks in mathematical programming, network planning, and queuing theory), to implement the tasks of

the ASUP is insignificant. This can be explained by the absence of a unified methodology for developing them and of a sufficient number of PPP's, which would satisfy different users. The analysis of the state of information base developed does not, in practice tolerate major changes and is used in conjunction with already developed technological designs. In individual cases, merging or subdivision of directories has taken place as a consequence of change in make-up or appearance of new tasks developed by the workers of the enterprise themselves.

Analysis of the organizational support of the ASUP's shows that the enterprises have created divisions for the automation of control of production (OAUP) or ASUP divisions, including the functional bureaus stipulated in the plan but that when these subdivisions were created, changes in the organizational and functional structures of the enterprises were not foreseen. Thus in the fulfillment of individual functions one sees a certain duplication and methods for performing the tasks of the ASU correspond to the traditional means for control which were formed long before the introduction of automated systems of control of production.

One should note, however, that the introduction of ASU's in enterprises has caused a certain degree of redistribution of the control functions in the subdivisions, organizations and functional management structures for the enterprises and has led to interaction of ASUP personnel with management personnel of the enterprises, thus increasing the efficiency of control. For example, functions of the production divisions of the enterprises such as the drawing up of specifications for components; the calculation of the range of application of the components in subassemblies and products; the calculation of assignments for each component; the generation of route sheets; operational calculation of makeup of component sets; recording of the fulfillment of the production etc. are now being accomplished by the ASUP divisions. Analogous shifts in the redistribution of functions are taking place in other structural subdivisions.

An important factor in the successful functioning of the ASUP is their support by the work forces. Analysis showed that the number of specialists for one ASUP varies from 60 to 200 people depending on the number of subsystems and control tasks performed in the enterprise. The personnel structure for one system was as follows: 10.7% were developers, algorithm specialists and task definers; 17.4% were program developers, mathematical programmers; 40.6% were personnel concerned with the operation of the complexes of technical devices and maintenance; 10.3% were personnel involved with preparing technical information media; 10.5% were personnel involved with the reception, output and delivery of materials; 10.5% were administrative-management personnel and people doing other work.

The results of analysis show that it is essential to diminish the relative share of personnel involved with operations, maintenance, preparation of media, and reception and output of information who now make up more than 60%. This negative phenomenon lowers the efficiency of the ASUP.

Analysis shows that automation of the control of an enterprise has a positive influence on the dynamics of variation of economic and technical indicators. As a result of the introduction of the ASUP, the following change in the controlled phenomenon took place (in % of the base year): intra-shift loss of work time for organizational and technical causes diminished by an average of 40%; expenditure of raw and other materials diminished by 1%; payment for overtime dropped by 18%; losses from defective output dropped by 15%; non-production expenses were reduced by 12%; the need for floating assets diminished by 3%. As a result the productivity of labor increased by an average of 3.5-5% (and in individual cases for example in the Minsk machine-tool plant imeni S. M. Kirov, the Vitebsk electromeasurement instrument plant imeni 60th anniversary of the October revolution, by 7.5%), the growth in the size of the implementation of production was 1-1.5%; the production cost of products dropped by 1%; the production regularity of the operation of the enterprise increased by 3.5-5% (and in individual cases by 7-8%); the load factor of production capacities increased by 1-1.5%; the number of administrative and management personnel decreased by 1.5-2%. The profit from the lowering of production cost averaged 5% of the total obtained in the enterprises studied. However, the actual proportion of profit obtained from the introduction of ASUPs is much greater than that since each ASU has this effect over a period of a number of years.

Thus the analysis of the level of economic efficiency of ASUP functioning shows that capital investment on the development and introduction of a single system of control created between 1975 and 1977 on the average was 1 million rubles, of which 300-350 thousand rubles is attributable to pre-production expenditure (development of the ASUP plan and computer programs). The cost of the hardware complex for conversion of information, as a rule is 550-600 thousand rubles; expenditure on the building or reconstruction of buildings to house the IVTs (Computing and data-processing center) does not exceed 50-60 thousand rubles. The calculation of the actual economic efficiency of the ASUP's studied shows that in practice all systems function effectively. The yearly savings for one system comprises on the average 350 thousand rubles. For individual enterprises, like the Vitebsk electromeasurement instrument plant, the savings was 580 thousand rubles; for "Gomel'mash" it was 619 thousand rubles, the coefficient of efficiency for capital investments was 0.5, the time for the system to pay for itself was 1.3-2.5 years.

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COMPUTERIZED RESERVATION SYSTEM

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[Article by S. G. Kavan, Deputy Chief of the Central Railway Office for Passenger Service of the Moscow Railroad, and V. A. Timukhin, Chief of Department of the Computer Center of the October Railroad]

[Text] A unified direct reserved seat and preliminary order reservations system based on the YeS EVM (Unified computer system) has been developed and introduced to improve organization of passenger transport and to improve passenger service on railway transport. The new system will encompass all the large terminals with passenger flow of not less than 10,000 passengers per day.

The new progressive form of passenger service envisions sales of direct reserved seat and return tickets at points of departure based on seat reservation by telegram orders. The passengers at practically any stations of the system can order tickets at the ticket offices for trains dispatched from the Moscow terminal. This method was first introduced at the Central Railway Office for Passenger Service (TsZhB) in Moscow.

Orders for direct reserved seats on trains from Moscow stations were transmitted through the computer complex of the unified system and the Akkord-1200 data transmission equipment on 14 railroads in 1978 during the mass summer transport season. This made it possible to accelerate processing of orders and to increase allocation of seats by almost eight percent at the requests of the railroads during the summer season.

Introduction of an automated accounting and direct reserved seat system significantly reduced the time expenditures for fulfilling the requests of passengers, freed the TsZhB dispatchers from manual sorting of 40,000-50,000 seats per day, improved the working conditions of the advance and daily ticket sales offices and eliminated the necessity of punching tickets at the capital stations for transit passengers. However, the new technique for reception and fulfillment of direct reserved seat orders could not be used as a typical system for other large terminals. Moreover, the experience of operating the accounting and seat reservation system

showed that, along with standardization of problems, it should provide selection of different versions of solutions when fulfilling orders, automation of return tickets, calculation of the cost of passage, allocation of tickets in real time, receipt of all statistical reports for passenger transport, operational planning of transportation for the railroads and the system and analysis of operation.

In this regard the Main Passenger Administration and the Main Administration of Computer Technology of MPS (Ministry of railways) decided to develop the new standard ticket reservation system to formulate direct reserved seats and advanced requests based on modern computer technology. Specialists of the Moscow, October and Southern Urals Railroads and the Technological Planning and Design Office of ASUZhT (Automated Railway Transport Management System) developed and introduced the first unit of this system in the Moscow and Leningrad terminals. It envisions allocation of seats up to 45 days prior to train departure and issue of display lists on seat availability to the associated railway offices of the system (CDB) on trains dispatched from the Moscow and Leningrad terminals 30 days in advance. During 1979-1980 it is planned to introduce the system on eight additional railroads of the system and further step by step development of it is planned.

Main Problems and Elements of the System

Problems related to ticket reservations, computer input and correction of normative and reference information and gathering, storage and printout of data on terminal devices on debarkation of passengers at intermediate points for repeat use of seats, preliminary checking of order fulfillment, compilation of operational and counting data on operation of the system and introduction of a system archives are being solved within the typical automated system.

Direct ticket reservations are the main problem of the system. The input data for solving it are contained in the order which includes two types of requisitions. The first type includes data on the passenger's trip required for any order: the data of departure, the required categories and number of seats and the cipher of the station of destination. Requisitions of the second type contain additional information whose presence permits reduction of the number of refusals of ticket allocation (indication of the possibility of replacing a number or category of a train--up to three interchangeable trains), control information and the cipher of the type of requirement. The presence of special requests ciphers permits stipulation of the possibility of ticket reservation for other categories or for other days (in the absence of tickets for the requested train) when the order is transmitted and also to provide reservation of all seats in a car or of only lower berths.

Ticket reservation when indicated in the order, acknowledgement of a change in the number of the train, seat category and date of dispatch (for

a period up to three days) are accomplished in the following manner. If there is no seat of the given category in the requested train, the possibility of making available those same seats in another train is considered and their category is changed only after this. The day of departure is changed only if there are no available tickets for other trains and other categories. This technique permits more complete satisfaction of passenger requests.

Orders are divided into group (with more than nine tickets) and individual according to the number of reserved tickets. The reservation scheme for both types of requests is the same on the whole. The difference of group from individual reservation includes only the fact that one group of available seats in the same car is initially selected and if this is impossible, then 10 groups of seats are selected. Two groups of seats can be selected by individual requests. Then, if the seats in one car cannot be selected as requested, seats in other cars of the same type are selected--not more than in two groups for individual orders and not more than 10 groups in group orders.

An individual request is considered satisfied if all the requested seats are allocated for it and a group request is considered satisfied if the seats are allocated at least partially. The type of request and additional information (the number of the train and rail car, the category and number of return tickets and the number of the first ticket in the group) should be indicated in the request for allocated return tickets. The presence of a protective code in the request (return) makes it possible to check the reliability of data on the numbers of the train and car and the type of seats.

In processing the order, ticket reservation is envisioned primarily in trailer and conventional cars (if the ciphers of the station of destination on the request and the car from the normative and reference information coincide).

Tickets within the automated reservation system are distributed by types of sales: by direct reserved ticket, collective requests, for the offices of orders and so on. The conformity of orders to the allocated norm of tickets is checked by the code of the city or the codes of the ticket offices by means of special tables.

Requests for input into the reservation system are prepared on punch tape--manually or by computer. The control sum is additionally indicated in each line of the information messages used for this purpose. The presence of these data permits one to check the quality of message transmission over communications channels.

The format and logic checks of requisitions of initial messages are made prior to processing the orders and errors in the type of request, seat category and station of destination are determined.

The results of ticket reservation calculations are issued on punch tape for transmission over communications channels or are printed according to the format of boarding stubs. In this case the main requisitions of the information message--the date of departure, the numbers of the train and car and the ticket category--are printed twice. The quality of transmitting the lines of the message over communications channels can be checked by the control sum compared to the response data for orders.

The normative and reference information (NSI) is entered from the storage devices to the computer during ticket reservation. The NSI includes conditional-constant and variable information. Conditional-constant information contains data on the reservation deadlines for types of ticket sales, the number of terminals encompassed by the automated system, the lines, names and ciphers of stations of designation and record of passenger debarkation and the names of graphs of individual allocated forms. The possibility of input and printout of reference tables is envisioned for the conditional-constant part of the NSI. This type of information is corrected during preparation of the system to operate under specific conditions.

Data on trains which are corrected when a traffic schedule is changed or when trains are entered and postponed, comprise the variable part of the NSI. When variable information is entered in the computer, a format check is made and when it is entered by individual components a logic check is made. Data on trains by which data are corrected are entered in a special file, printed out and stored until the deadline for entry or cancellation of the train begins. Automatic correction of the seat norm is made after this. This approach to management of this most crucial information with timely input of messages permits a final check of it at the points of origin--the subdivisions of the passenger service and only then can it be used in the automated system with the least time expenditures.

Automation of ticket reservation requires clear checking of availability and sales of them. Solution of the problem of compilation of operational and accounting data on system operation for this purpose permits one to obtain objective information on seat availability in trains for the first 18 or all 45 days of the reservation period, a list of seat availability by lines and dates and the percent ratio between sold and available seats by dates, categories and trains. Accounting for reserved and cancelled seats by cities and orders with errors has been automated.

Solution of this problem makes it possible to improve the management of passenger transport and to designate and cancel additional trains on a more justified basis.

Development of a reservation system made it possible to automate such a laborious and crucial process as investigating deficiencies in work committed by passenger personnel. Management of the system archives has been

included in the complex of problems solved for this purpose. All data on fulfilled and cancelled orders and those unfulfilled due to nonavailability of seats are stored in the archives for one year. The archives are processed and information is issued on the occupation or availability of any seat allocated by the system by means of a special program.

The automated system ensures ticket reservation for different periods and types of orders. For example, orders for direct reserved tickets for the TsZHB of Leningrad are processed within a period from 45 to 7 days and collective orders are processed within a period from 45 to 19 days. The remaining tickets are then transmitted for subsequent automated sales or for manual sales.

When converting to manual sales, the information on seats for which the reservation deadlines have terminated is printed out from the computer by the schedule-chart format for rail cars. All available and reserved seats are noted on these schedule-charts.

The new system is directly related to the complex automated control system of ticket-office operations of the Moscow terminal Ekspress. All remaining tickets not used in the reservation system are transmitted to the Marshrut computer 10 days prior to train departure for sales in the ticket offices of TsZHB and branch offices.

A schedule of the system is compiled by means of special programs and the processes of input and erasure of train information in the computer complex storage is controlled.

Organization of advance check is included in the complex of problems solved by the system to check the correctness of order transmission. Format and logic check of the information in requests coming from the serviced area to other reservation systems is accomplished by means of this problem. Automatic sorting of requests is accomplished on the basis of lists of available seats transmitted from other systems. Requests for which there are no available seats are eliminated.

Accounting of seats available as the train progresses (more than 10 percent of the passengers usually end their trip at stations of debarkation) has been automated. Gathering of information from the accounting stations for each train for the entire reservation period is provided for this purpose on the basis of data on ticket reservation and cancellation. After the reservation deadline has terminated, data on passenger debarkation is sorted by the cities from which the orders came and are issued in special format on punch tape for subsequent transmission to the addressee.

All the problems of the automated system are closely related to each other. The results of solving the problem of input and correction of normative and reference information are used when entering requests and reservations for tickets. The responses are the basis for preparation of operational and

The passage document from the station of departure to the station of destination is formulated if the passenger does not have to transfer and a ticket for passage in the general car from the initial to the final station and two paid receipts up to the required category with seats (from the station of departure to the station of transfer and from the station of transfer to the station of destination) is formulated if it is necessary to transfer during the trip. If the passenger cancels the trip, the seat is transmitted to the LDK with indication of its check code.

The LDK punches all requests received from the stations and prepares telegrams which are transmitted to the railroad computer center directly to the computer or the teletype room. Responses to requests and lists of available seats on the system are issued from the computer center. Moreover, the requests of passengers, as in the ticket offices of line stations, are received here.

The operating technology of the ODB (TsZHB) is similar to the LDK. Moreover, the LDB determines the seat norm stored in the computer memory, establishes the reservation for this norm, checks the use of tickets, solves problems of operational planning of seat distribution and establishes the frequency and format of issuing an operational-reference report. The entire seat norm for the reservation points (within 45 days) is entered in the computer, data on changes in the layout of rolling stock and the travel routes of trains are corrected and so on. The seat norm is transmitted to the current sales ticket offices two days prior to train departure.

During formulation of a passenger request, the ticket agent records his number, date of departure, the station code, the type of request, the number and numbers of the interchangeable trains, the type and number of seats, the code of the station of destination and the passenger's name in a special log. The number of the request and the date of appearance for formulation of passage documents are communicated to the passenger.

Requests are entered in the log in the order of their receipt without selection by reservation points, dates and trains. The responses are recorded opposite the corresponding requests. The date of departure, the station code, the numbers of the train and rail car, the type of rail car, the numbers of the first and last tickets, the total number of tickets and the control sum of the response are indicated in the responses.

The following methods are used to check the quality of the information of preliminary documents: visual (the operator who punches out the request on the teletype compares the information on the teletype tape to similar data of the log), semantic (the ticket agent checks the corrections when responses for requests are received), logic and format checking of requests and responses by computer.

The requests for tickets are encoded, punched in the form of a model message and are transmitted to the computer center over communications channels.

accounting data, management of the system archive and accounting for passenger debarkation. Preliminary checking of requests and direct communications with other systems permit complex solution of all the problems and increase the reliability and productivity of the ticket reservation system.

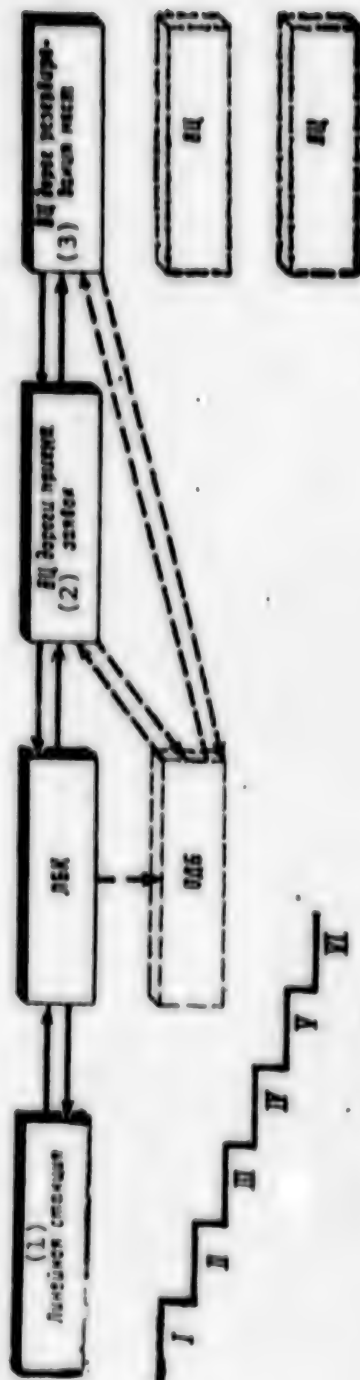
The hardware complex of the system, along with the calculating devices, includes data preparation apparatus (the T-63 teletype), information reception and transmission by telegraph and telephone channels (telegraph apparatus and Akkord-1200PP devices). The possibility of readout and recording of information on magnetic tape by using the YeS-9002 apparatus coupled with the Akkord-1200PP is provided to accelerate information transmission and to increase the operational reliability of the system during data reception and transmission. The YeS EVM used in the system has been equipped with magnetic disc and magnetic tape stores and punch tape and punch card information input devices. The internal storage capacity comprises 256 kbytes.

The Technology of System Operation

The automated train ticket accounting and reservation system mutually links the operating technology of of passenger stations, line ticket offices, combined railway offices and railroad computer centers for passenger request service.

Let us consider the overall scheme of functioning of the unified system. Passenger stations (LS) take requests and issue response for ticket reservations on long-distance trains. Line ticket offices (LBK) gather requests from the stations and formulate telegrams for transmission to the ODB or VTs and receive and transmit telegrams with responses to requests to the stations. The combined railway offices check the normative-reference information--the reference manuals of the stations and lines and the ticket norm on trains entered in the system. The computer center makes reservations according to the transmitted orders, issues reference data for checking ticket sales, makes an advance check of requests prior to issue of them to other systems and implements measures to increase the reliability of data during data transmission to other reservation centers.

Orders for formulation of train documents for direct reserved seats are received at the stations from 45 to 2 days prior to train departure. When a request is received, the ticket agent takes into account the total time required to obtain the seat and to formulate the ticket. Lists of ticket reservation points have been prepared by the passenger services for each station and the minimum required time to formulate passage documents at these points has been established. When a request is recieved, the ticket agent coordinates all the possible types of changes with the passenger and indicates not less than two interchangeable trains in the request. A special schedule has been developed to transmit orders from line stations and information on seat availability from reservation points.



Technological Process of Seat Reservation By Direct Reserved Ticket and Advance Orders: I--receipt of requests and issue of responses to requests; II--transmission of requests to LBK and transmission of responses to requests from LBK; III--encoding and punching of telegrams with requests, transmission of telegrams with requests to the computer center of the railroad in question; IV: 1--sorting of requests by railroads of destination; 2--logic and format checking of requests; 3--protection of requests by the control sum; 4--checking of seat availability; 5--logic and format checking of responses; 6--checking the control sum; V--transmission of requests to the ticket reservation computer center and transmission of responses from the computer centers; VI: 1--entering of requests, logic and format checking of requests and checking the control sum; 2--request processing; 3--issue of responses and list of seat availability; 4--issue of operational and reference information; 5--miscellaneous operations.

Key:

1. Line station
2. Computer center of request receiving railroad
3. Computer center of ticket reservation railroads

A punched tape with encoded and punched requests is the machine information carrier. The corresponding time standards have been established for preparation of input information.

Telegrams or individual requests not accepted for processing are determined during the course of logic and format checking of primary documents entered in the computer. Messages on detected errors are transmitted to the request formulation points.

Processing of orders and solution of reservation problems in the computer center are divided into two steps: preparatory and main. The LBK and ODB requests are checked for reliability and completeness of information in the first step. They are then sorted by railroads of reservation and are checked for conformity of the requested seats to their availability. The control sum is added to the texts of the checked requests and the telegram is transmitted to the reservation computer center. The responses received after the check are transmitted to the LBK and ODB. Data on ticket availability at the reservation points arrive daily together with responses from the computer centers.

Requests arrive at the computer of the computer center reserving the tickets during the course of the main step of order processing. The following operations are carried out here: format and logic check of requests, ticket reservation, issue of responses and lists of ticket availability and operational-reference information, change of the date, ticket norm and preparation of the complex for operation during the next session.

Several request processing sessions can be carried out at the computer center as a function of the load level. The length of one session should not exceed 5-6 hours. The number of request processing sessions for each computer center is calculated according to the total volume of requests, computer productivity and the length of the session.

The input and output information is checked and corrected by means of computer or directly by operators (visual checking of operational-reference information entered in the computer by the ticket norm and changes made in it).

The length of request processing in railroad computer centers should not exceed 24 hours from the moment the request arrives until a response is transmitted. Information on orders is transmitted over communications channels. Operational-reference information arrives at the passenger service of the reservation railroad no later than 10:00 of the following day.

If the schedule is changed, the passenger service personnel transmit information for formulation of NSI files to the computer center not less than two months ahead. Operational changes in the files are entered in the computer not less than two days after the corresponding telephone call or

telegram has arrived. Correction of the ticket norm is permissible when trains are entered or cancelled, with changes of station of destination, the period of plying and the time of train departure, input and removal of rail cars from the train, changes of the ticket norm, categories, numbers of rail cars, stations of destination of rail cars with variable sign and trailer cars. All the NSI files are stored on magnetic tape at the computer center.

The automated ticket reservation system should be introduced in steps with connection of the corresponding points as they become ready.

The experience of organizing passenger transport at the Moscow and Leningrad terminals indicates the high effectiveness of the new system.

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SAVINGS REALIZED BY USE OF COMPUTERS

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[Text] Computer introduction on railway transport has achieved large scales. The first unit of the automated railway transport control system (ASUZhT) has now been introduced.

Approximately 1,000 problems of more than 200 designations is now being solved in railway transport computer centers. Approximately half of them are related to fulfillment of functions of transport organizational control and the remaining part are related to production processes. The former include problems in the field of planning, normalization, accounting, monitoring and analysis. Part of the solved problems is optimization in nature (development of schemes for normal directions of freight traffic volume, the forming-up plan and train traffic schedules and some others).

A significant increase of computer use in railway transport by expansion of the range of problems solved in the ASUZhT, especially production-optimization problems, development of information and reference systems, including dialog-reference systems, and also data transmission equipment, is being provided during the current five-year plan and in the future.

The purpose of existing and newly developed automated systems and also the individual problems solved by using computers is improvement of railway transport management based on increasing the effectiveness of production and economic activity of the railroads and their line subdivisions, optimization of the shipping process and operational control of shipments, increasing the operational level of all subdivisions of railway transport, repair enterprises and subways, improvement of operational-statistical and bookkeeping accounting and other types of economic activity.

Further development of the ASUZhT requires large capital investments to acquire hardware and also current expenditures to ensure functioning of the systems. Capital investments to development of ASUZhT comprised 74 million rubles during the Ninth Five-Year Plan, while this sum should be increased twofold during the 10th Five-Year Plan.

The temporary Method of determining the economic effectiveness of automated control systems and problem-solving using computers in railway transport has been developed at the All-Union Scientific Research Institute of Railway Transport and has now been confirmed by the Ministry of Railways for more efficient use of the funds allocated for development of the ASUZhT. It was compiled on the basis of the Method of determining the economic effectiveness of automated enterprise and production association management systems, confirmed by the State Committee of the USSR on Science and Technology, Gosplan of the USSR and the USSR Academy of Sciences in 1978, and also the Procedural instructions to determine the economic effectiveness of new technology, inventions and inventors' proposals in railway transport, confirmed by MPS in 1978.

Let us consider the main propositions of the temporary procedure.

Efficiency Indicators

The saving from introduction of automated systems in railway transport is determined by the increase of railroad profits due to additional freight shipments as a result of optimizing the use of shipping facilities, by saving current expenditures through reduction of consumption of material and labor resources in the production sphere and by reducing labor expenditures during data-gathering and processing related to the problems being solved. The results of functioning of automated systems and introduction of the corresponding problems should be reflected in the production activity indicators of railroads and their line production subdivisions.

A significant saving from introduction of the ASUZhT has also been achieved outside transport. Its sources are an increase of the rate of freight delivery and the saving of passengers' time, more efficient shipments, an increase of freight preservation, a reduction of expenditures for tare and packing with an increase of container shipments and so on.

The index of the annual saving and also the cost-accounting indices of efficiency--the annual increase of profits (saving of expenditures) and the calculated coefficient of the effectiveness of capital investments (or the inverse value--the payback period)--are used to estimate the effectiveness of expenditures to develop ASU [Automated control system] and to solve problems or complexes of problems by using computers. Each of the named indices performs the functions inherent to it.

The index of the annual saving is designed to select the versions of new equipment, including development of ASU, and also for calculating the

bonuses for new equipment for development and introduction of ASU. This index is calculated by the following formula:

$$B = \sum S_i \pm C^A + E_n (K_i - K^A) + B_{nz}.$$

where S_i is the reduction of annual operating expenses for i -th element of expenditures in the operational sphere, S^A is variation of the annual current expenses related to information processing, the saving (+) and increase of expenses (-), K_i is the saving of capital investments in the operational sphere for the i -th element of expenditures, K^A is capital investments related to introduction of the evaluated ASU (or problems using computers), E_{nkh} is the annual saving achieved outside transport and E_n is the normative coefficient of the economic effectiveness of capital investments in new equipment ($E = 0.15$).

The basis for comparison is the corresponding indicators of expenditures in the absence of ASU, but with regard to a possible increase of the technical level of production and the volume of shipments (operations) assimilated during the year of calculation in the presence of ASU. The year of calculation is understood as the year following introduction of a system into operation. Many factors affect variation of the indices and if the effect of the ASU on these indices cannot be evaluated directly, the variation is determined on the basis of the calculating procedures or by using data of similar problems or expert analyses already introduced and also the corresponding norms of expenditures related to these indices.

The index of the annual increase of profits (saving of expenditures) used to evaluate the economic results due to development and functioning of ASU or solving individual problems and complexes of problems using computers in the cost-accounting indices of the operations of railroads and their subdivisions is calculated by the formula:

$$\Pi^A = \sum C_i \pm C^A + \Delta \Pi,$$

where $\Delta \Pi$ is the increase of transport profits due to additional freight shipments as a result of releasing shipping resources during the year.

The achieved increase of profits is established on the basis of comparison with the expenditure indicators of the following year after introduction of the ASU (or problems and complexes of problems using computers), but without regard to the effect of the ASU.

The basis for the increase of profits due to additional shipments is the increase of freight traffic volume provided in the plans. The release of freight cars achieved as a result of optimization of transport processes is taken as the synthesizing index of release of shipping resources.

The calculated coefficient of economic effectiveness (or payback period) is designed to determine the effectiveness of capital investments in development of ASU (solution of individual problems or complexes of them using computers) and is established by the following formulas:

$$E_p = \frac{\pi^A}{K_K^A} \geq E_{\text{нвт}}; T = \frac{K_K^A}{\pi^A},$$

where E_p is the calculated coefficient of effectiveness of capital investments for development of ASU, K_K^A is the capital investments for development of an ASU without regard to preproduction expenditures not included in the cost of the main production funds, $E_{\text{нвт}}$ is the normative coefficient of the effectiveness of capital investments to development of the ASU and solution of problems by using computers (it was established as 0.33 for railway transport) and T is the payback period in years.

Determining the Production Effect

The production effect due to functioning of an ASU in railway transport is expressed in improvement of the use of rolling stock, equipment and permanent facilities and a reduction of the contingent of workers and a saving of fuel, electric power and materials.

Solving production-optimization problems will ensure a reduction of all or part of the named types of labor and material resources. The use of computers in solution of accounting-statistical problems leads to a reduction of the labor expenditures of personnel engaged in processing accounting-statistical information and also to a reduction of its processing times. All this in the final analysis improves the operational and production activity and ensures a saving of production resources.

Variation of the full-scale quantitative indices must be determined to calculate the production effect. Thus, variation of the operational indicators of the locomotive and rail car fleet is established to solve problems related to shipping activity. A reduction of the idle time of rolling stock for repair, a saving of material and labor resources and also better use of the production funds of repair enterprises are determined to evaluate the results of solving problems related to repair and routine maintenance of transport hardware.

Variation of full-scale indices as a result of introduction of ASU or solution of individual problems by using computers can be established at the pre-planning and planning stage of development on the basis of the corresponding engineering calculations and economic-mathematical methods and also data which characterize the effectiveness of already introduced similar ASU or of individual problems. If the required data at the initial stage of calculations are absent, variation of one or another indices can be determined for calculation of the production effect through expert

analysis. The results from introduction of systems or problems should subsequently be refined on the basis of analyzing the actual variation of the corresponding indicators.

If the effect in the form of variation of qualitative indicators is known, it must be expressed in monetary evaluation in variation of quantitative (volumetric) indicators--time indicators (variations of rail car-, train-, container- and locomotive-hours of train, marshalling yard and mileage indicators; rail car- and locomotive-kilometers of a single run). This recalculation is made on the basis of traditional formulas.

The saving of current expenses and capital investments achieved as a result of better use of rolling stock is determined from these indicators and by the consolidated norms of expenses for each of the calculated measures. In this case, capital investments are applied to the calculation only for the annual saving.

When determining the increase of profits and the calculated coefficient of the effectiveness of capital expenditures for development of an ASU (or the corresponding payback period of these capital investments), only the saving of current expenses related to reduction of the value of the measures, except for variation of rail car-hours, is calculated.

The saving of rail car-hours is used in the given case to calculate the increase of profits due to additional freight shipments. As noted above, the method of determining the economic effectiveness of ASU introduction provides for analysis of the return of capital investments in development of the ASU not only due to profits from reduction of expenses, but also due to the additional volume of products. For ease of calculations, profits may be related to any one measure of operation, for example, for the "rail car-hours" measure, to which the volume of shipments is closely related. The value of additional profits achieved with an increase of shipments as a result of acceleration of rail car turnover can be calculated per one rail car-hour on the basis of the average daily productivity of a freight car, the profitable rate per 10 ton-kilometers and the cost of freight shipments dependent on the volume of operation.

If the fraction of dependent expenses is equal to 0.4-0.5 under conditions of current planning, the mean value of additional profits per one rail car-hour is equal to approximately 90 kopecks. However, the possible reduction of the productivity of rail cars used for additional shipments must be taken into account due to an increase of empty runs compared to the average value of delays related to unpreparedness of the locomotive fleet for additional shipments. Therefore, it has been decided to take two-thirds of the additional profits per rail car-hour, i.e., 60 kopecks for calculation.

A reduction of container-hours creates the possibility of additional switching of freight shipments to the container method of delivery. Since

an increase in the volume of container shipments may occur due to small and rail car dispatches, the cost of shipment of which in box cars is a different ratio to the cost of container shipments, it has been decided not to take into account variation of profits in part of shipping operations in the given case, but to determine only the reduction of expenses for loading-unloading operations.

For approximate calculations, the saving for loading-unloading operations can be taken as equal to two rubles for each ton of freight additionally shipped in containers.

The results of solving problems expressed in reduction of the mileage of freight cars (elimination of turn arounds, reducing empty runs and so on) are evaluated by the consolidated rate of expenses per unit mileage (1,000 rail car-kilometers). Unlike the unit expense rate per rail car-kilometer, which includes only expenses for inspection and routine repair of rail cars, the consolidated rate should include all expenses related to movement of rail cars in trains and handling of them at servicing yards.

Many consolidated expense rates for measures of rail car and locomotive operation can be taken from data available in the economic reference manuals compiled on the railroads and many divisions for calculations under specific railroad conditions.

When evaluating the results of solving problems related to improvement in organization of repair and improvement of the use of station equipment, the savings should be determined by direct calculation on the basis of the norms of equipment utilization, expenditures of labor and material resources and deductions for depreciation of basic funds.

In the absence of norms, the input data can be taken from the results of analyzing actual expenditures. The monetary expression of this effect in the form of the annual saving should be determined on the basis of existing prices, wage rates and the dimensions of additional payments.

The real production result cannot be calculated for some accounting-statistical and information-reference problems since the problems have not been solved. The conditional effect measured by the achieved saving of labor related to gathering and processing of the corresponding information and output of finished data as a result of using computers can be determined in this case compared to the extent to which labor would have to be expended to achieve these same data in the absence of computers.

The Non-Transport Effect

As already indicated, the non-transport effect, which is not expressed in economic indices of its activity due to the characteristics of transport as a sector of material production, and of the achieved effect is formed in many cases as a result of developing automated systems and introduction of computers in railway transport

Besides the saving of transshipping facilities, acceleration of freight movement and a reduction of circulating funds of the national economy are achieved by reduction of rail car-hours. The achieved monetary saving is estimated by the known formula on the basis of the average price of one ton of shipped freight, the average load of the rail car and reduction of the rail car-hours of freight cars. If the name of the freight by which acceleration of movement is achieved is known, the price is taken as equal to the wholesale price of the given freight.

When the section speed of passenger trains is reduced, we feel that one should take into account the saving of passenger time achieved from this in passenger-hours annually and the saving achieved in the national economy should be established through the monetary estimate of one passenger-hour. According to calculations based on the estimate of the cost of the national income per one calendar hour per capita and with regard to the fact that the most active part of the populace makes use of transport to the greatest extent, one passenger-hour can be estimated as equal to 30 kopecks under modern conditions.

When solving optimization problems related to making freight shipments more efficient and reduction of their mileage, a reduction of consignor expenses is achieved for the corresponding haulage rates. At the same time railway transport loses a specific part of profits due to shipments. In total, the national economy achieves a saving due to elimination of inefficient shipments in an amount equal to the saving of current railroad expenses (reduction of haulage rates minus the loss of profits).

If the volume of containers and the saving of container-hours achieved from this is accelerated, it is possible to ship additional freight in containers. Thus, the national economy achieves a saving of expenses for transport tare and also a reduction of circulating funds with regard to acceleration of freight movement in containers.

The saving of expenses for tare can be calculated from the mean productivity of the container per year in tons and the saving of expenditures for transport tare calculated for one ton of freight switched to the container method of delivery. This value comprises an average of 18.5 rubles/ton and depends on the type of freight.

The saving of expenditures outside transport is taken into account when determining the annual saving. When estimating the cost-accounting indices of effectiveness, this effect is not expressed in the profit achieved. Therefore, it should be taken into account additionally together with the increase of transport profits or "as a balance" in order to have a proper idea of the total effect due to introduction of the ASUZhT.

Calculating Variation of Expenditures for Information Processing

Variation of current expenses for processing input information used in solution of production and accounting-statistical problems based on

computers is established by comparing expenses with existing methods of obtaining data and automated systems.

The existing technique of obtaining data combines in itself different methods of information processing and related expenditures on information processing by hand and on keyboard and perforation calculators. With automated information processing, routine expenditures include the cost of manual processing (encoding, recording of indices and other manual operations), preparation of input information carriers and checking of them, information transmission to the computer center and return by users and automated information processing. The volume of operations for computers is measured by the amount of input information in thousands of characters and also by the machine time of problem-solving.

The saving of routine expenditures for information processing is determined as the difference between the annual routine expenses with existing methods of information processing and those when using computers. One-time expenditures for development and introduction of automated control systems consists of pre-production expenditures and capital investments for development of ASU.

Pre-production expenditures include expenses for scientific developments on ASU, including development of algorithms and programs, tie-in of standard planning decisions, experimental operation of the system, training and retraining of personnel and so on. Capital investments in ASU include the cost of acquiring the computer equipment, peripherals, means of communications and construction of buildings and structures.

When determining the economic effectiveness of solving individual problems, the capital investments in computers are taken as proportional to the fraction of machine time required for a given problem from the total annual budget of useful computer operating time. Expenditures for communications equipment are calculated in proportion to the volume of information transmitted over communications channels with respect to the total volume of ASU information as a whole.

In those cases when capital investments for development and introduction of ASU are realized over a number of years and operating expenses for maintenance of ASU vary due to variation of operating conditions by years of operation, the economic effectiveness of the ASU should be determined with regard to the time factor.

The Results of Calculations

Based on the developed procedural propositions, experimental calculations were made to determine the economic effectiveness of some automated systems and individual problems solved by using computers (see table).

	Annual saving, thous. rubles	Annual Increase of Profits, thous. rubles		Calculated Coefficient of Effectiveness, percent		Period of Return, years	
		Within transport	Within transport with regard to the nontransport effect	Within transport	Within transport with regard to the nontransport effect	Within transport	Within transport with regard to the nontransport effect
Classification yard ASU	192.7	449.2	553.7	36.7	45.3	2.7	2.2
Processing the information of railroad agencies in three calculation-commercial offices	61.7	106.9	106.9	52.0	52.0	1.9	1.9
Calculation of wages at the locomotive depot	4.6	7.3	7.3	50.0	50.0	2.0	2.0
Calculation of monthly freight shipment plans on the railroad	80.5	33.6	94.9	210	530	0.5	0.2
Handling the unit trains of the engineer on the railroad	64.8	109.8	109.8	50.0	50.0	2.0	2.0
Technical diagnosis of predicting the mileage of diesel locomotives between repairs by using computers on the railroad	355.3	387.0	387.0	190.0	190.0	0.52	0.52

The data indicate the very high economic effectiveness of using computers and introduction of the considered automated systems in railway transport.

The essential factor for analyzing the effectiveness of some problems is taking into account the nontransport effect. Specifically, the main effect for container terminal ASU which determines the feasibility of introducing it is created outside transport with regard to the possibility of achieving a saving for tare and the freight mass enroute due to a saving of container-hours and an increase of container shipments. The nontransport effect is also formed with introduction of classification yard ASU and when using computers to calculate the monthly freight shipment plans. In the latter case this effect is formed as a result of eliminating inefficient freight shipments.

Besides the monetary indices of effectiveness, full-scale indices can also be estimated. Thus, by knowing the achieved reduction of man-hours of working time and the annual fund of this time per worker, one can establish the average reduction of the contingent. The saving of the contingent comprises 31 persons in the considered example of a classification yard ASU. This saving will be equal to 99 persons in the problem related to processing of railway agencies and it will be equal to 18 persons when calculating the monthly plans on the railroad. The saving of the operating rail car fleet can be calculated by dividing the released rail car-hours by the number of hours annually (8,760). This saving comprises 124 rail cars in the problem for classification yard ASU.

The use of the considered procedural propositions under diverse conditions of using computers in railway transport permits one to make technical and economic calculations for each specific case. These calculations will contribute to economic expenditure of funds directed toward acquisition and functioning of computer equipment and also to an increase of ASUZhT efficiency.

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NEW COMPUTER TRAINING LAB FOR INSTITUTE STUDENTS WORKING WELL

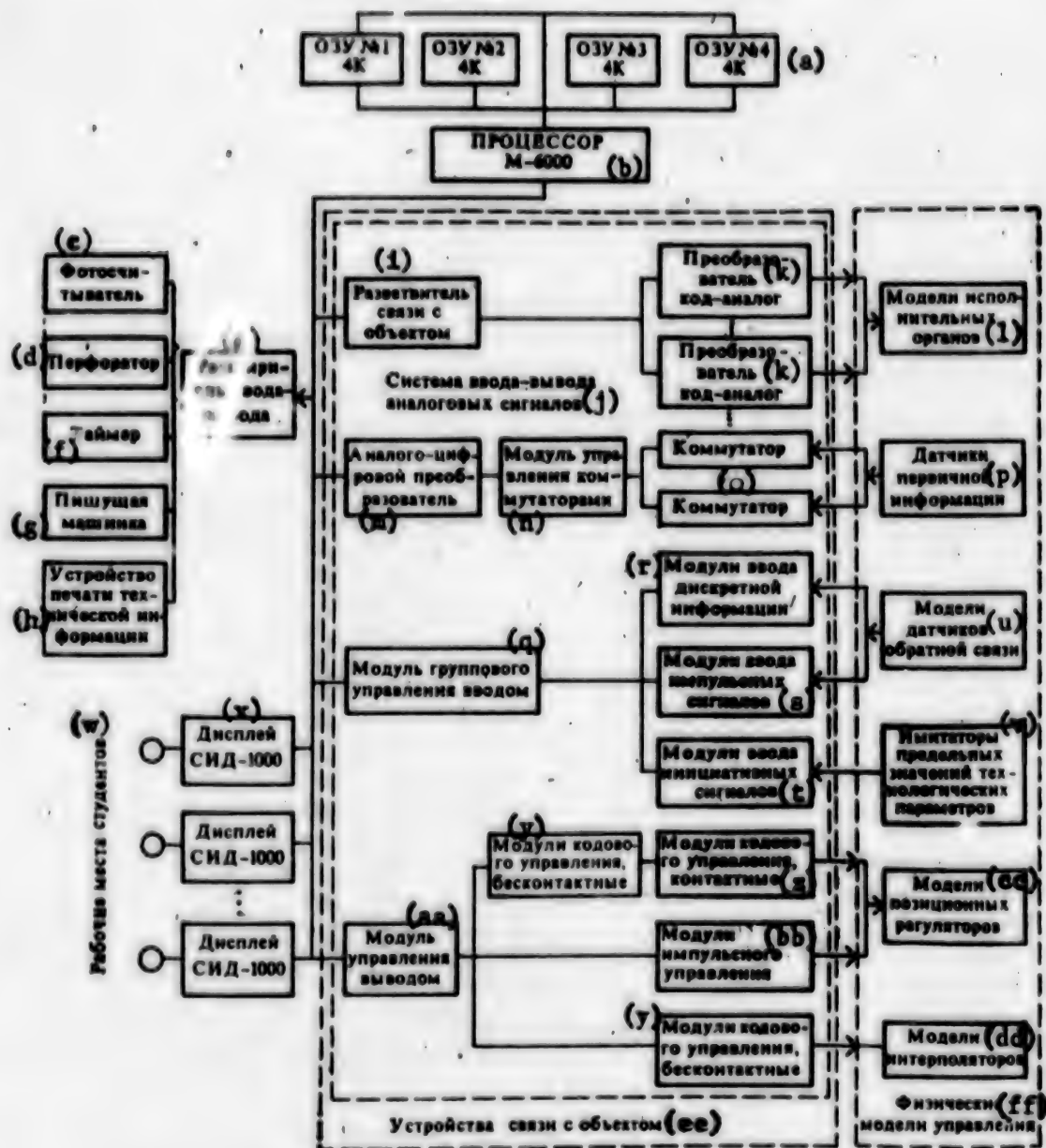
Moscow VESTNIK VYSSHEY SHKOLY in Russian No 1, 1980 pp 21, 22, 23

[Article by Professor S. I. Goncharov, rector, Professor V. Ye. Shukshunov, and Docent V. G. Zhukovskiy of the Novochoerkassy Polytechnic Institute: "The Multiconsole Dialog System Is Working"]

[Excerpts] Our institute has set up a training laboratory in the department of automated control systems (see photograph). The lab has a multiconsole dialog system with time sharing. It uses a M-6000 minicomputer and SID-1000 alphanumeric displays. The system allows a group of students to work at the consoles at the same time and translate and debug programs in a dialog regime. In addition, the system is linked to many different types of hardware (simulators and models of control objects, test stands, data transmission and conversion channels) and can control them (see figure, next page). This set of hardware is used for classes in the courses in automatic control theory and systems of data transmission and conversion, which enables students to study modern computer-based control systems directly.



We have developed special software for this system that permits programs to be translated and debugged with no particular difficulty. The translation system is fed to the computer once at the beginning of work and programs are edited using the display hardware.



- Key: (a) Main Memory [No 1, No 2, and so on, 4K apiece];
 (b) M-6000 Processor;
 (c) Photoreader;
 (d) Punch;
 (e) Input/Output Expander;
 (f) Timer;
 (g) Typewriter;
 (h) Technical Information Printer;
 (i) Branching Device for Communication with Object;
 (j) Input/Output System for Analog Signals;

- (k) Code-Analog Converter;
- (l) Models of Actuating Elements;
- (m) Analog-Digital Converter;
- (n) Commutator Control Module;
- (o) Commutator;
- (p) Raw Data Pickups;
- (q) Module for Group Control of Input;
- (r) Modules for Input of Discrete Information;
- (s) Modules for Input of Pulsed Signals;
- (t) Modules for Input of Initiation Signals;
- (u) Models of Feedback Pickups;
- (v) Simulators of Threshold Values of Technological Parameters;
- (w) Work Positions of Students;
- (x) SID-1000 Display [three identical units shown];
- (y) Contactless Modules for Coded Control;
- (z) Contact-Type Modules for Coded Control;
- (aa) Output Control Module;
- (bb) Modules for Pulsed Control;
- (cc) Models of Position Regulators;
- (dd) Models of Interpolators;
- (ee) Devices for Communication with the Object;
- (ff) Physical Models of Control.

Our system is now being used for the education of students specializing in automated control systems. Immediately after studying "Introduction to Programming," they take a practical laboratory course entitled "Work at the Computing Center." Working directly with terminals, the students perform various assignments involving both computing and data processing. Other practical courses given in the laboratory are entitled "Fundamentals of the Structure of Automated Control Systems," "Theory of Computing Systems," "Data Representation Systems," "Systems Modeling," "Designing Subsystems and Elements of Automated Control Systems," and others.

Students from the field of applied mathematics also work at the laboratory. For them we have organized practical classes in the elements and design of automated control systems, systems modeling, systems programming, and the like.

The system is also used by students working on class and diploma projects and for practical computer experience. First-year students in the specialization of automated control systems are able to spend one hour each day of individual work on the computer during their practical experience course.

Eight students can work in the lab at one time. Each of them is given an individual display which shows the text of the program and forms

special computer access instructions to carry out machine translation of the program and subsequent calculations using this program. A time-sharing system is used for communication with the computer (the quantum of time may vary from one to 524 milliseconds). This mode creates the illusion of working individually with the computer; students become convinced personally of the great capabilities of computer technology.

Our experience has demonstrated that if the system is used for 65 hours a week, students have 500 hours a week for individual work. Thus, each student in the specialization works directly on the computer for more than 15 hours a semester. Taking into account practical work this will be more than 200 hours for the entire course of study.

In the future we intend to broaden the capabilities of our system by connecting in a powerful series-produced YeS-1033 machine. This will enable us to convert the departmental training laboratory into one that serves the larger school.

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CONFERENCES

ALL-UNION CONFERENCE ON THE AUTOMATION OF CONTROL SYSTEM DESIGN

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 79
pp 141-142

SHKURBA, V.V. and MEYTUS, V.YU.

[Abstract] The all-union conference on the automation of control system design was held on 17 - 19 April, 1979 in Suzdal, and was organized by the USSR National Committee on Automatic Control and the Institute of Control Problems of the USSR Academy of Sciences. Some 300 representatives of 138 organizations and institutions in the USSR participated in the program, presenting 101 reports, 13 of which were read at plenary sessions. Authors, titles and brief descriptions are cited for many of the papers, and the following topics of the six working sections were noted: 1. Automating the design of production control systems; 2. Automating the design of technological process control systems; 3. Automating the design of the technical equipment of control systems; 4. Language software for automation of design; 5. Optimization problems in the automation of control system design and simulation modeling; 6. The generation and debugging of software, as well as theoretical aspects of the automation of programming. The concluding remarks by academician V.A. Trapeznikov noted not only achievements in the field of theoretical and practical developments, but also a number of negative aspects, in particular, duplication of developmental work, the slow pace of system implementation, the lack of information on the effectiveness of existing systems and the lack of general requirements placed on automated design systems. The deficiencies are to be eliminated by the Scientific and Engineering Committee on the Automation of Control System Design, created by a resolution of the USSR National Committee on Automatic Control.
[183-8225]

THE UTILIZATION OF THE UNIFIED SYSTEM OF ELECTRONIC COMPUTERS AND MATHEMATICAL MODELING IN THE APPLICATIONS SECTOR

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 79 pp 142-143

ABRAMOV, S.B.

[Abstract] Some 70 specialists took part in the school on the "Utilization of the Unified System of Computers and Mathematical Modeling in the Applications Sector" which was held in Moscow on 10 - 14 April, 1979 at the USSR Exhibition of National Economic Achievements. The school for the exchange of experience was organized by the Central Mathematical Economics Institute of the USSR Academy of Sciences and the Main Administration for Propaganda, Subject Material and Procedures of the USSR Exhibition of National Economic Achievements. The reports included the following: "Problems of Optimizing the Treatment of the Means of Production", "Conditions for the Efficient Utilization of the Unified System of Computers in the Applications Sector", a report dealing with questions of the organization of data banks as applied to the unified system of computers for solving problems of fuel supply and the report "Modeling the Processes of Accessing the Means of Production in Complex Systems (Nation, Industrial Sector, Region)". Considering the as yet small amount of experience in the utilization of the unified system of computers in supply organs, it was recognized as expedient to hold such schools on a regular basis.
[183-8225]

THE 13th ALL-UNION SCHOOL ON THE AUTOMATION OF SCIENTIFIC RESEARCH

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 79 p 143

ONOPRIYENKO, M.M.

[Abstract] The 13th All-Union School on Scientific Research Automation (ANI) was held on June 1 - 10, 1979 in Krasnoyarsk. Some 250 persons, including 5 members of the USSR Academy of Sciences participated in the Program where primary attention was devoted to questions of the use of modern computer equipment, information computer complexes, and the utilization of the newest component base in ANI systems, as well as to problems of software for these systems. The instructional program included the following: 1. Lectures devoted to the primary ANI problems; 2. A cycle of instruction on the CAMAC standards; 3. Laboratory work with CAMAC equipment; 4. Three working sections: one on ANI system software, one on problem oriented complexes and a section on hardware. The laboratory work on CAMAC equipment was organized by the Special Design Office for Scientific

Instrument Construction of the Siberian Department of the USSR Academy of Sciences. It was noted that automating experiments of low and moderate complexity using the IEEE-488 standard make it possible to design systems which have such advantages as the capability of the wide use of series produced instruments, programming simplicity, flexibility and reliability and little equipment redundancy. The 14th School is planned for 1980.
[183-8225]

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Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 6, 1979 p144

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[278-2291]

2291

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[Annotation of monograph]

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LIST OF RECENT ARTICLES ON COMPUTER TECHNOLOGY

Moscow LETOPIS' ZHURNAL'NYKH STATEY in Russian No 3, 1980 pp 33-36

[List of articles with reference information]

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